SCIENTIFIC AMERICAN

No. SUPPLEMENT 63

Scientific American Supplement, Vol. III, No. 63.
Scientific American, established 1845.

NEW-YORK, MARCH 17, 1877.

Scientific American Supplement $5 a year.
Scientific American and Supplement, $7 a year.

THE ST. GOTHARD TUNNEL.

Our engraving is a perspective view of the works at the north tunnel—Goeschenen, in Switzerland. The entrance of the tunnel is just under the watchman's building, marked 8. The south end of the tunnel is at Airolo, on the opposite side of the Alps. *Engineering* says that twenty-three air compressors, which deliver about 42,360 cubic feet of air hourly into the tunnel at 105 lbs. pressure, are at work at each end. They are divided into seven groups, five of which comprise three cylinders or 15 in all, 16½ in. in diameter, 25·6 in. stroke, and two groups of two cylinders each 24·4 in. in diameter, and 36·22 in. stroke. To these 19 compressors are combined four smaller ones for supplying the locomotives which work at a pressure between 75 lbs. and 150 lbs. These 23 cylinders are actuated by six Girard turbines, supplied through the large main which descends on the north side, from the Val des Schöllenen. A double system of canals supplies the turbines on the south side from the waters of the Tremola and the Tessin. Before being delivered into the reservoirs from the compressors, the volume of air is increased by two slow speed compressors on the Sommeiller system, at first driven by steam power, but now by water pressure. Along the course of the main, between the points of entry and exit, two sluice valves are introduced, and a minimum pressure regulator. These regulators are especially intended for the following functions: when from any cause, most frequently from the *debris* resulting from a blast, the air main is broken in the tunnel, the compressors which then work under vacuum at once increase their speed, beyond the extreme limits for which they are designed, before time is given to close the sluices. The automatic regulator, however, shuts the main as soon as the pressure falls to a given limit, and excess of speed is thereby checked.

In describing the meams employed to perforate the tunnel, it is natural to direct attention first to the two principal means employed—the compressors and the perforating machines. These are in reality one combination of two essential organs, the former compressing the air outside the tunnel, and the latter employing the force thus developed against the face of the rock, the link of connection being the iron main which leads the air from the point where it is compressed to that where it is employed. Before proceeding, therefore, to a detailed description of the exterior works, we will refer briefly to the drilling machines employed.

The drills employed at St. Gothard—Ferroux, Mackean, Turettini, Dubois-François—give collectively about 600 strokes per minute against the face of the rock, an average expenditure of air per minute of 882 cubic feet at atmospheric pressure is required. This amount may be increased to 1,055 ft., including that required for ventilating purposes, after each blast. At present 35 drills are at work in the tunnel, arranged as follows: Seven in front of the rock face of the small heading, and 16 at the work of enlargement; that is to say, four at each of the four points of attack, 12 below and six at each of the upper levels. Thus a maximum of 40 drills may be assumed. These 40 drills require 4,200 cubic feet of air per minute. The seven groups of compressors furnish 42,360 cubic feet of air at a pressure of seven atmospheres per hour, or 706 ft. per minute, equal to 5,642 cubic feet at atmospheric pressure, so that the amount delivered is in excess of the requirements.

In 1872 the first stroke of the drill was made against the granite flanking the Finsteraahorn. The narrow valley on which the northern entrance opens was then a desert, strewn with boulders, brought down from the surrounding heights. On the 15th of December, 1876, the heading had reached a distance of 24,700 ft., or about half the length of the tunnel, which is to be opened for traffic on the 1st of October, 1880. The total length of this tunnel will be 9½ miles. It will form a connecting link between the railway system of Germany, Switzerland, and Italy, and is built under the special auspices of these three nations. A profile of the mountain, and a general description of the great work, illustrated by 24 figures, is given in Scientific American Supplement, No. 26.

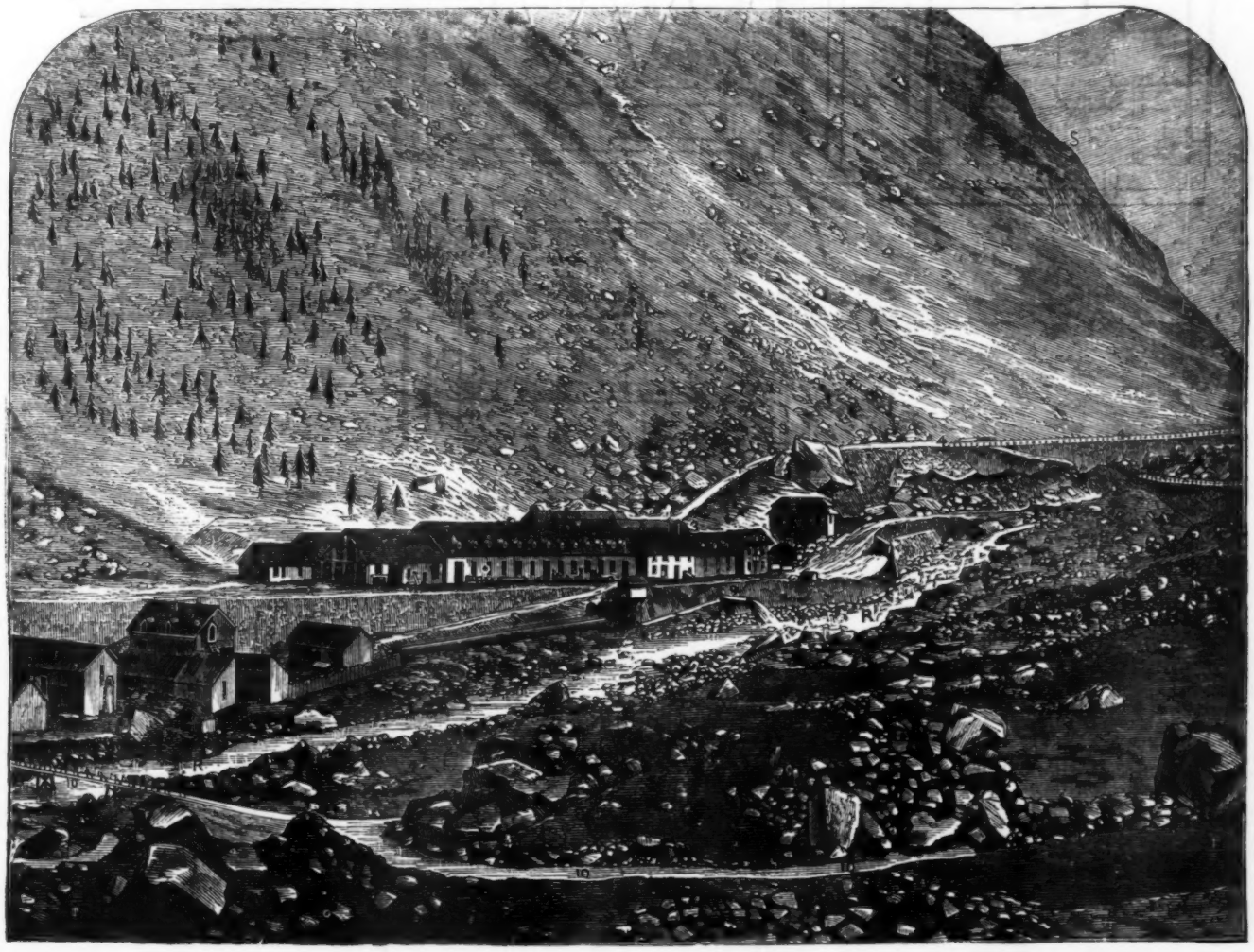
TREE PLANTING BY RAILWAY COMPANIES.

The Central and Southern Pacific Railway Companies have begun a system of tree planting along their right of way, which is to be carried on extensively and scientifically. They have decided to use the different species of the Eucalyptus tree, and have already planted largely with the *Eucalyptus Globulus*, or blue gum tree, in Alameda County. This is the only tree of the genus to be found in any quantity in this country, and the supply is grown in nurseries at Oakland. The other species are mostly natives of Australia, and embrace varieties adapted to almost every kind of soil and climate. The companies have sent to Australia for a supply of seeds. The wood of most of the varieties is saturated with resinous gums, making it tough, heavy, and exceedingly durable for railway sleepers and telegraph poles. Rostrata sleepers have been known to last twelve years.

The *Eucalyptus Marginata*, which for some time has been extensively exported from the southwest of Australia and used for railway sleepers, will be set out along the hilly tracts and ledges along the roads. The *Eucalyptus Rostrata*, which grows in Southern Australia, and in places in which the climate and character is very similar to the redwood districts of California, will be used for river bottoms and wet lands generally. The *Eucalyptus Brachypoda*, which flourishes in the arid, tropical inland regions of Australia, will do equally well, it is thought, in the desert tracts of California; and the *Eucalyptus Obliqua*, which rapidly attains gigantic dimensions in the poorest of soils, and can be used for any purpose above ground, will be set out in those places along the railroads where other Eucalypti will not thrive.

Three rows of trees, from six to twenty feet apart, will be set out on each side of the track. They are of very rapid growth; in Algiers a two-year-old tree is twenty feet high. The companies will, therefore, in all probability be able to reap the benefits of their enterprise in a very few years. The expected benefit is principally in having a good supply of valuable timber for ties, etc., constantly at hand and well distributed. It is also expected that a favorable influence will be exercised upon the climate, and that increased rainfall may result where it is needed. Remarkably good results of this kind are said to have followed the introduction of the Eucalyptus in Algiers, and the malarial districts of Italy were improved in the same way. The Catalpa tree, which makes excellent ties, is also to be tried. Mr. Scupham, who has the work in charge, has already received a large supply of the seeds from Ohio.

This method of utilizing the vast amounts of waste land comprised in the right of way of railway companies is commendable. It will prove in the long run a measure of great economy to the company adopting it, while at the same time benefitting the neighboring country and beautifying the route. It is probably too much of an investment for the future to be undertaken very generally in these times of depression. But the question of the timber supply of the future is an important one, and if trees of valuable wood and rapid growth can be found, the plan should be adopted by all railway companies as soon as they can consistently.—*Chicago Railway Review.*

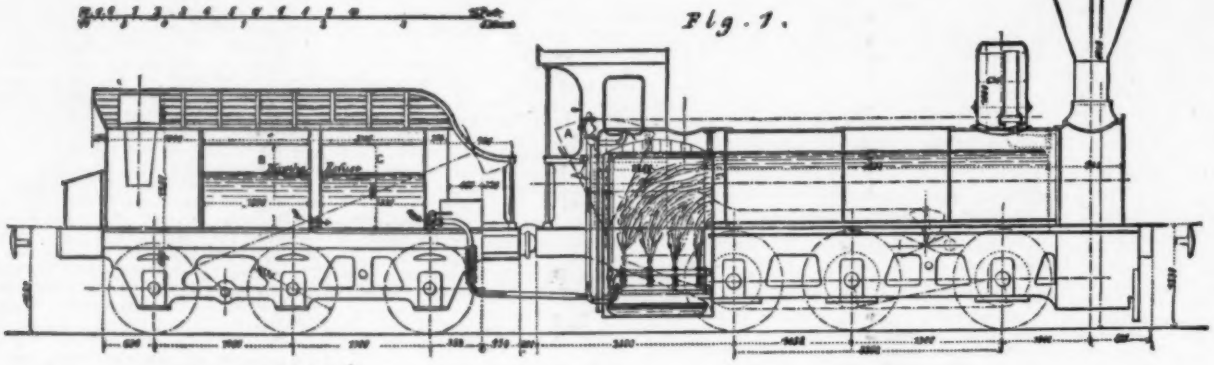


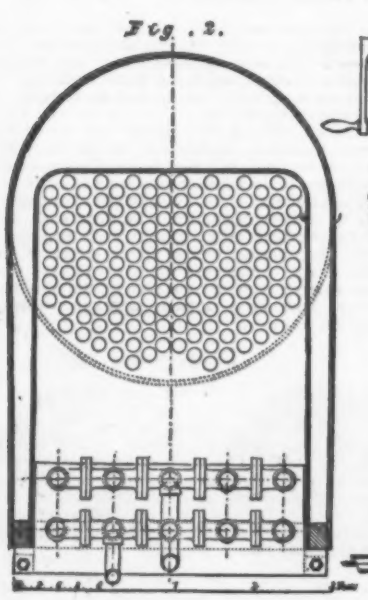
ENTRANCE TO THE GREAT ST. GOTHARD TUNNEL THROUGH THE ALPS, SWITZERLAND.

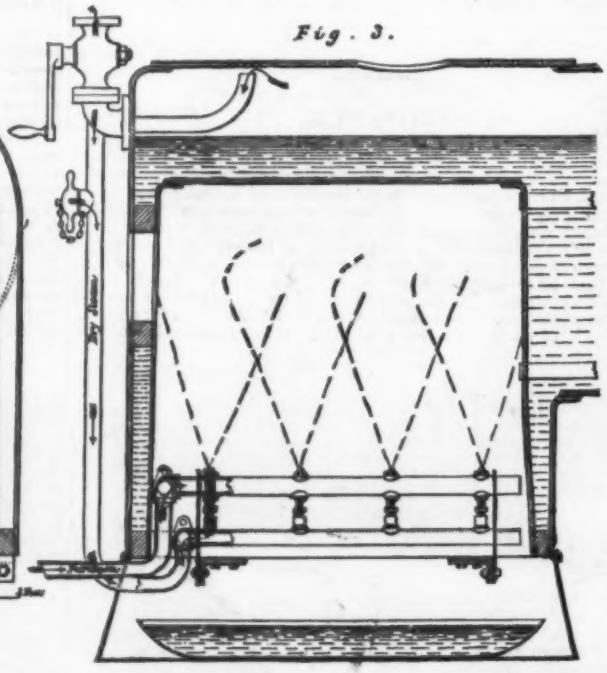
PETROLEUM LOCOMOTIVES.

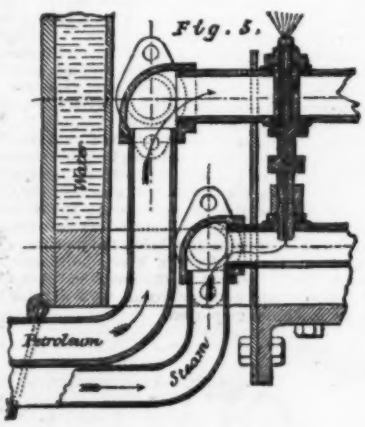
We annex engravings showing arrangements for burning crude petroleum in locomotives, designed by Mr. Thomas Urquhart, the locomotive superintendent of the Griazi-Tzaritzin Railway, on which line the apparatus has been successfully used. The rapid construction of railways in Russia during late years has given rise to a proportionate increase in the price of wood fuel, while the mineral resources of the country have not yet been sufficiently developed to enable the railways to be supplied with coal in large quantities. It was under these circumstances that Mr. Urquhart was asked by Mr. Xloodinoff, the managing director of the above named line, to design an apparatus for burning crude petroleum, this petroleum being found at Baku on the Caspian Sea, and transported by water up the Volga to the terminus of the railway at Tzaritzin.

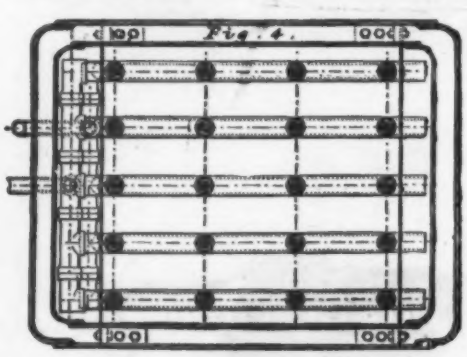
LOCOMOTIVE FOR BURNING PETROLEUM. DESIGNED BY MR. THOMAS URQUHART.











The arrangement of the apparatus will be readily understood from our engravings. From the general view, Fig. 1, it will be seen that the crude petroleum or naphtha refuse is carried in portable tanks placed on the tender, these tanks being connected to each other, and also to a flexible pipe leading to the engine. Figs. 2, 3, and 4 show the arrangement fitted to the firebox, while Fig. 5 is a section of one of the jets drawn to a larger scale. From these views it will be seen that the firebox is fitted with five parallel pipes, which spring from a cross pipe at the rear of the firebox, this cross pipe receiving a supply of petroleum by the pipe leading from the tender, as shown. Below each of the five parallel pipes, above mentioned, is a corresponding steam pipe, each steam pipe being fitted with four jets of the construction shown in Fig. 5. From this view it will be seen that each steam jet is surrounded by an annular passage to which the petroleum has access, and it thus injects a spray of petroleum into the firebox. As will be seen from Fig. 3, provision is made for taking in air mixed with the steam.

On several occasions when the apparatus was first tried, gas explosions occurred on the firing door being opened, these explosions being accompanied by a loud report and large volumes of flame rushing from the firehole. Such explosions, however, can, of course, be avoided. When running, steam is maintained very easily. When standing, much smoke is sometimes made, but when running and with a fair draught sufficient air is taken in to consume the smoke properly. The water in the ashpan serves to receive any drops of petroleum which may leak over.

Although successful from an engineering point of view, yet the use of petroleum on locomotives does not pay commercially in Russia. In 1874 the price of petroleum on the Volga was 40 kopecks per pood, or about 13d. or 26 cents per 36 lbs. On a trial with a train of 30 empty covered wagons weighing about 176 tons, and taken up an incline of 1 in 125, the consumption was about 2 poods per verst, or about 109 lbs. per mile, a quantity too great to warrant the adoption of such a system. At the same time circumstances may arise in which petroleum may be profitably used by locomotives running in the neighborhood of oil wells, and for this reason the experience of Mr. Urquhart is of much interest.—*Engineering.*

NEW RAILWAY STATION AT YORK, ENGLAND.

The *York Herald* gives particulars of the extensive works in progress for the North Eastern Railway Company at York, of which the result will be one of the greatest railway stations and hotels in the world.

The building was originally designed by Mr. Prosser, architect, but on his retirement it devolved upon Mr. B. Burley. He, however, died, and Mr. Peachey, the North Eastern Company's architect, assumed the charge of the works. Hence several alterations of the original plan were suggested and carried out. Before commencing with the main structure there were many preliminary works to be done, and these were intrusted to Messrs. Nelson, contractors, of Carlisle. The contract of Mr. Keswick, York, for the erection of the station and hotel, was accepted, and the work progressed satisfactorily for a time, but a long strike on the part of the workmen caused much delay, and ultimately a contract was entered into with Messrs. Lucas & Brothers, of Lowestoft and London, to complete the work. The iron work of the roof was undertaken by Messrs. Butler, of Stanningly, and as soon as they could begin they made such rapid progress that the roof is now almost finished. The station is built upon a curve, in order to allow of the trains from the south to go through northwards without the backing, changing, and other inconveniences which had to be endured in connection with the old station. The structure is no less than 800 feet long by 234 feet wide, and this great area will be entirely devoted to through and local passenger traffic. The roof consists of four semicircular spans, the largest of which is the north centre one, 81 feet wide, and covering four lines of rails. That springing from the north wall is 55 feet wide, and embraces a platform and three sets of rails for local through trains. The two southern spans are 55 feet (covering three sets of lines) and 43 feet (covering two sets) respectively. These two terminate, one at the entrance platform and the other at the iron screen leading to the octagonal entrance of the hotel. The roof is carried on cast iron columns with longitudinal wrought iron girders and ribs, and on these is fixed a roof of woodwork pannelled out and pierced with skylights along the centre of the ribs from end to end.

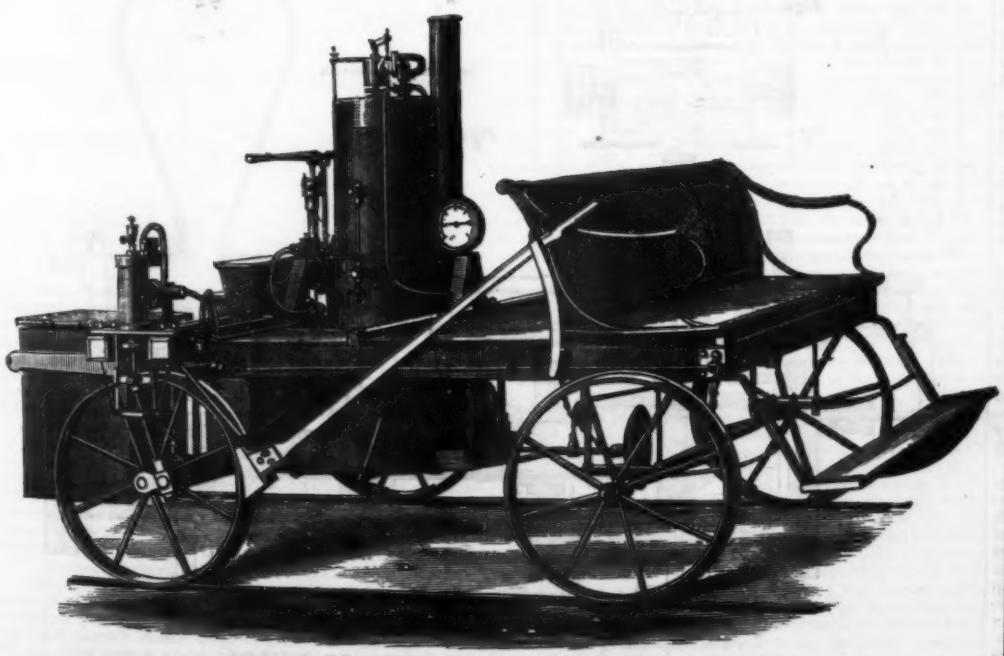
The walls of the structure are of Scarborough facing bricks, and the height of the roof is 42 feet, measured from the platform level to the under side of the girders of the main span. To prevent the effects of a strong wind glazed screens will be placed at the ends of the roof. Passengers will cross from one platform to another by subways, which will be entered by slopes or steps. The subway walls are composed of white glazed bricks, and these corridors only await the construction of the superincumbent road and platform to be completed. They are of ample width and height, and in every respect calculated to facilitate the easy and quick traveling of a large number of passengers from platform to platform.

The universal opinion is that the building is too low, a height of about 40 feet being out of proportion with the large area which it covers. One circumstance which perhaps would have caused some incongruity had the roof been carried higher is that the building is one storied only, all the offices being on the ground floor.

The entrance to the station will be from the south side through a portico. It is 150 feet by 55 feet. In height it corresponds with the central main block, and the roof, which is now completed, is of iron in nine bays pierced with skylights. The spaces between the columns which support it will be occupied by some balustrades in keeping with the general character of the portico. This latter work is now in course of construction, and will soon be completed. Passing through this portico the booking hall is reached. The hall is 41 feet by 36 feet, having ticket offices on each side. There are two entrances from the portico to the booking hall, with windows on each side. The center of the roof is of glass, which is supported by light iron girders, springing from the hammer beams. The portico and ticket hall are now being floored. Immediately behind the ticket offices on the right of the hall is the first-class refreshment room, 70 feet by 30 feet. Entrance will be obtained from the outside by easily accessible passages to the bar, while into the room itself access will be gained from the platform. The second-class refreshment room is contiguous, but is reached by a distinct passage. This room is 40 feet by 25 feet. On the same side are the stationmaster's office, second-class waiting rooms, lavatories, and other offices, while the other side is occupied by the first-class waiting rooms, and left and lost luggage office. The rooms for porters and other officials, and many minor offices, are all of ample dimensions, and complete in every respect. There will be a large open space in front of the portico, and at each end of the central block, so that that there will be abundant room for vehicles, and should there be any crowding at the portico on any special occasion, the large open space between the end of the portico and the hotel will afford accommodation for the overflow. This space will lead to the platform, but will be separated from it by an iron screen of elaborate construction, with a sliding gate in the center. By this passengers will be able to go directly to the hotel through the octagonal entrance, and so avoid the inconvenience of threading their way through a crowd of passengers at the principal exit. The columns supporting the two southern spans are continued to the main block across the area just alluded to, between the hotel and station buildings, and a colonnade of less altitude, but identical in style, has been added. In consequence of the curvature and great length of the station, it will be impossible to see trains approaching either end with accuracy, so that they will have to be worked in and out by means of signals. In order to effect this a signal box will be fixed in the center of the entrance platform, but will be so constructed as not in any way to detract from the general aspect of the surroundings. With it a book stall will be combined. The platforms will be asphalted, with stone walls and copings. There is a good deal of the interior work yet to be done, but everything is fast approaching its ultimate condition.

The hotel, which is situated north-eastward of and adjoins the station, is a building of five stories, namely, basement, ground floor, first, second, and third floors. The length of the north front is 272 feet, of the east front 99 feet 9 inches, and of west front 48 feet 5 inches, there being three wings with areas intervening at the south side. The rooms have been arranged with a view to convenience and pleasantness, those likely to be most frequented being so placed that charming views of the River Ouse, the Museum grounds, and the Minster will be obtained from the windows. A path, 10 feet wide, will be made round the hotel for the convenience of foot passengers. All the timber is brought from the Baltic to Lowestoft, where it is partially prepared, and then conveyed to York to be finished on the ground. The stone is from Tadcaster, Whitby, and Ancaster, and the iron work is sent from Stanningley. The bricks are supplied by Messrs. Bolckow, Vaughan & Co., Middlesborough, Mr. S. N. Smith, Scarborough, and Messrs. Nelson, of Carlisle. After the station and the hotel have been completed there will be a great many minor matters to be attended to, but the most important of these will be the laying out of the ground between the hotel and the River Ouse, which is to be converted into a garden. Commodious engine sheds are in course of construction, and are already built up to the roofs. These sheds will accommodate 60 engines. They occupy a position to the north of the Scarborough railway close to the river. The building is constructed of red brick, and will be roofed with slates, supported by iron ribs, and will be lighted by means of skylights. The ground plan of the structure is three squares joined, each being 165 feet square, so that one portion is 330 feet by 165 feet. In each of these is a turntable which will accommodate 20 engines. An extensive block of warehouses and goods sheds are also being erected nearly a quarter of a mile further from the city than the existing warehouses, and about the same distance north of the new station.

The extensive works connected with the new station have been carried on under the superintendence of Mr. Clemence, Messrs. Lucas Brothers' manager. Mr. F. Smith is the North Eastern Company's clerk of works. Mr. J. Shires superintends the roofing and other works of Messrs. Butler, and the foremen of the several departments are respectively Mr. J. Service, of the joiners; Mr. T. Blyth, of the bricklayers; Mr. Giles, of the masons; Mr. Brown, of the plasterers; and Mr. Manning, of the painters. There are between 700 and 800 men employed upon the work, which is progressing rapidly and successfully, but it is yet uncertain when the new station will be opened for traffic. An effort will be made to open it on May 29, to commemorate the opening of the old station upwards of thirty years ago.



STEAM TROLLY. DESIGNED BY JOSEPH GREEN COOKE.

NARROW-GAUGE PROGRESS.

THE *Railway Age* says that narrow-gauge building on this continent may be said to have begun in 1871, only six years ago, and its progress may be noted as follows: 1871, miles of narrow-gauge built, 179; 1872, 450 miles; 1873, 555 miles; 1874, 819 miles; 1875, 585 miles; 1876, 569 miles. Total in operation in America, 3,157 miles. These figures are nearly correct, though, probably, not entirely complete. This shows an addition of 569 miles of narrow-guage track in twenty-one States—more than one-fifth the total number of miles of railway constructed in the country during the year, according to most authorities. For a system practically of recent introduction, and which is still considered by many of doubtful economy and efficiency, this certainly is a very encouraging showing, and indicates that, in spite of the assertions of some that narrow-gauge roads will not and must not be built, they have been and will continue to be built. The thirty-three roads whose extensions are noted above have now a total length of nearly 1,000 miles, and this is less than one-third of the total narrow-gauge mileage now in operation in America. The number of narrow-gauge roads in operation in America is over 100, besides an indefinite number projected.

NARROW ESCAPE OF THE ST. LOUIS BRIDGE.

THE great steel bridge at St. Louis was rendered impassable by a recent fire which consumed the woodwork of the eastern approach. The fire was communicated from the burning of some adjoining frame buildings, and it was only with great difficulty that it was prevented from crossing the river upon the bridge. The portion damaged extends from the ticket office at the eastern end of the bridge eastward about 1,000 feet. All the combustible material, flooring, etc., was consumed, and the ironwork was much warped and twisted. The entire damage can probably be made good by an expenditure of about $50,000, leaving out of account the interruption of traffic. The company has on hand many duplicate parts of the ironwork, and the reconstruction will not take many days. The water pipes and hose of the bridge failed utterly to do any service, and the flames were subdued by the city fire department. The loss might have been almost entirely prevented but for this failure.

GERMAN RAILWAYS.

AT the close of 1875 Germany had 15 084½ miles of railway in operation. The ratio of fatal accidents in 1875 was 1 to every 2,012,000 passengers carried. The number of persons killed upon German railways in 1875 was 509; and upon English, 1,265. The number of persons injured upon German railways in 1875 was 1,585; and upon English, 5,755. The number of passengers carried upon English lines is so greatly in excess of the numbers conveyed in Germany, that the proportion of persons killed to total carried is 50 per cent. greater in Germany than in England.

STEAM TROLLY.

WE give two views, prepared from photographs, of a novel form of steam trolly constructed by Mr. Joseph Green Cooke, the locomotive and carriage superintendent on the Oude and Rohilkund Railway. The upper one represents the trolly placed on the line of railway ready for traveling, while the lower one shows it in course of removal from the rails to admit of the passage of an expected train. The trolly is capable of being removed from the line by three men in 50 seconds, and for that purpose is formed in three parts; namely, 1, the fuel and water boxes; 2, the boiler, frame, engine, and one pair of wheels; and 3, the leading wheels.

In removing the trolly from the rails, the front end is lifted and the small turntable or pivot is let down, and rests upon the ballast, as shown in the lower view. This operation leaves the leading wheels standing upon the rails; the man who raised the front end of the trolly then removes the wheels from the rails, and the two other men remove the fuel and water boxes from the other end. The men then return to the trolly, and pull it off the line, having previously turned it on the turntable or pivot at right angles to the rails, as shown in our illustration.

The trolly has one steam cylinder only, this being 3¼ in. in diameter and 6 in. stroke, and the connecting rod being coupled direct to the one end of the driving axle. The boiler is constructed on the Field system, and is similar to the Field boilers adopted by Messrs. Merryweather for their steam fire engines, with the exception of the chimney, which in this case is outside and not through the center of the boiler. There are 12 square feet of heating surface composed of 36 Field tubes. The working pressure is 100 lbs. to the square inch, and the boiler is fed by a pump worked by the hand, as shown in our illustration. The diameter of the wheels of the trolly is 2 ft., and the speed, in fair weather with seven persons, is from 18 to 20 miles per hour; against a heavy wind, the trolly has done as much as 10 miles per hour.

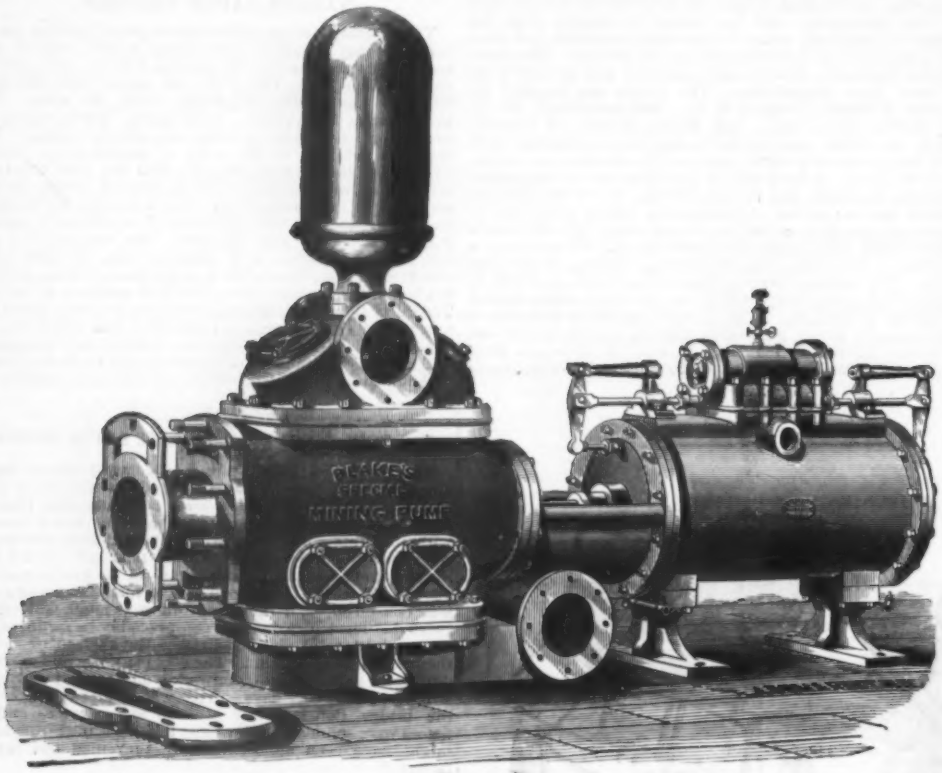
The boiler maintains steam perfectly. It weighs when empty 156 lbs., and contains from 3 to 3¼ gallons of water. The fuel box and water tank together weigh when empty 50½ lbs., and will carry 50 lbs. of charcoal and 6 gallons of water.

Each pair of wheels with their axle weighs 85 lbs. The engine weighs 45 lbs., exclusive of the crank and axle, and the total weight of the trolly in running order is 9 cwt. 3 qrs. 11 lbs. The water tank is too small for a long run, but with the addition of a leather "mussok," which the water carriers use, a run of 15 miles can easily be made.—*Engineering.*

THE BLAKE PUMP.

As a part of the unprecedented hydraulic exhibition at the Centennial, the display of steam pumping apparatus made by the Geo. F. Blake Manufacturing Co., of Boston, was equal to anything there in extent and variety, and exceeded by far anything done in this way by a single concern at any previous exhibition. In their exhibit was to be found some representative form of every one of their special productions; including wrecking, vacuum, tannery, tank, sugar-house, plantation, oil refinery, oil line, mining, marine, hydraulic, fire, circulating, brewery, feed, air, and acid pumps; and blowing engines; and in dimensions these ranged from the large double-acting plunger mining pump, of 11 tons weight, to the smallest boiler feeder.

It would have been hardly possible for one in search of a power pump, for any known purpose to which such a pump is applied, to look there without finding something adapted to his wants.



THE BLAKE SPECIAL MINING PUMP.

These machines, many of them, possess special features which, even in this most thoroughly worked field, and despite the great competition existing in this line of manufacture, commend themselves to the mechanic and intelligent purchaser.

The large double acting plunger mining pump, the weight of which is mentioned above, illustrates in many ways the care taken and the ingenuity exercised by this well known firm in providing for every contingency to which such a machine is likely to be subjected. In the use of the steam pump, perhaps more than in almost any other machine that may be mentioned, does the one consideration of reliability at all times become the most serious and important. More disastrous results have come of the failure of the steam pump, through, perhaps, some minor defect, to be in working order and remain so in some emergency, than is true of any other machine. More than once has the writer been placed in an unenviable position while at sea on a naval vessel, through the failure of some insignificant part of a steam pump, rendering it inoperative just at the time when most needed; and on one occasion the entire machinery of the vessel had to be stopped with the ship laboring in a dangerous manner in a heavy seaway during a storm for over an hour, through the displacement of a valve in the only boiler feed pump, and which necessitated pipe connections being broken and other work to be done which occupied that time before it could again be made operative.

Again, a steam pump will often do most excellent service so long as it is permitted to jog along doing only a moiety of the work of which it is reputed capable, until it, by some imperative necessity, is called upon to work up to its maximum capacity, and perhaps under some more than ordinarily adverse conditions; when through malproportion or oversight, in the design or arrangement of some minor feature of the machine, it reveals its weak point, and disaster results from its refusal to operate at the most critical time.

The mining pump mentioned is one of the largest of its kind made, the steam cylinder being 28" diameter, the pump cylinder 16", and the stroke 24". It is of the double plunger kind, and has a capacity of 2,000 gallons per minute. It possesses many features which are specially designed to meet the peculiar demands of a pump for this purpose; a noticeable one of which is that the side rods which connect the two plungers are supported by two short half circle bearings, leaving no rubbing surface upon which the grit or dust, so inseparable from mining operations, can lodge and destroy the bearing by the consequent wear. They are made to lift from 100 to 1,200 feet as may be required.

One of the latest additions to the lists of pumps manufactured by this firm is that given in Fig. 5, and called the "Special Mining Pump, with removable cylinder," and it certainly embodies all the requisites for a machine for that purpose. It is pretty well understood that for all purposes where the water to be lifted may hold gritty substances in suspension, as in the drainage from mines, the plunger pump is the best and least liable to destructive wear; but it is also advantageous to use pumps which are double acting, and a plunger pump can only be so made by having a double plunger, one entering each end of the cylinder as in the large mining pump above described, or a long single plunger packed at the middle. Either of these forms of pumps necessarily occupies a considerably greater length than a piston pump double acting and of equal capacity; and in many situations the space occupied by the pump is a matter of insuperable importance. To meet the demand for a machine which may be used to pump gritty water without rapid and ruinous wear to those parts of it which cannot be quickly and cheaply renewed, and which shall occupy no more space than the piston pump, this special pattern has been designed; and the peculiar feature in it which permits of the combination of these two important features in the same machine is a most felicitous one. In the wear of a piston pump from the action of gritty water, both water, piston, and cylinder must suffer, and it has been no difficult matter to provide for all such ordinary wear in the piston by the expansive action of the leather "cup" packing peculiar to this concern; but to compensate for similar wear in the cylinder is a much more difficult matter. This has, however, been accomplished by this firm in a most ingenious and effective manner, by fitting to that part of the pump ordinarily constituting the barrel, or cylinder, a removable cylinder, and furnishing with the pump an extra one of these, which may be substituted for the new one in a very few minutes, without removing any other part of the pump. The engraving, Fig. 21, represents one of these pumps with 18 inch steam and 9 inch water cylinder, and 36 inches stroke, and is, without doubt, one of the most complete and reliable machines for pumping water, under varying conditions as to freedom from gritty matter, yet produced. The removable cylinder is shown partly removed.

In this pump the plates upon which the water valves have their seats are made of composition, each valve plate being a separate casting, and all the working parts which come in contact with the water; as the piston rod, stuffing boxes, valve bolts, etc. are of the same material. The water valves may be examined very quickly by the simple removal of four nuts which secure a bonnet near each valve, and without disturbing any other part of the pump, or disconnecting any of the pipes leading to or from it.

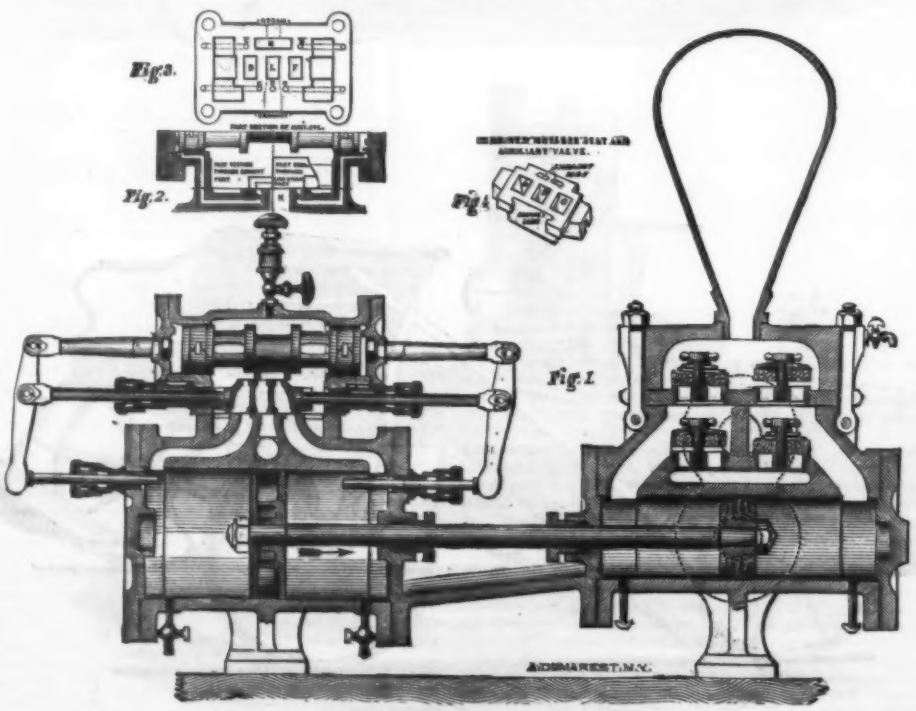
One of the most important features in this pump is that a smaller diameter of water cylinder may be substituted at any time that the pump may be required to discharge under a greater head than the maximum of which it was capable under the steam pressure obtainable, as first set at work; and this is in some circumstances a most desirable change to make. For example: in the sinking of a shaft, as it deepens, the head under which the pump must discharge increases proportionally, and if it is to have a considerable depth—for one pump to be in use for the entire sinking—either such pump must be worked at a disadvantage under the light lift at the commencement, or be incompetent to work at all under the higher head toward the end. But with this arrangement of removable cylinder, the machine may be such as to perform the initial work economically, and by substituting a smaller cylinder and piston at the water end of the machine, be as fully competent to perform proportionally the heavier work of clearing the deepened shaft. In this way the Messrs. Blake provide for the reduction of a pump cylinder of 14 inches diameter to as small as 4 inches in a very few minutes. All parts of this machine are made to uniform gauge, so that substitution can be made with certainty of fit. This is, no doubt, one of the most important improvements in pumping machinery that has lately been produced. The first of these was built for the Riverside Coal Company, Plainsville, Pa., where it has since been in successful operation.

This company have on the list of steam pumps made by them over 2,000 distinct varieties, which fact alone is something to be astonished at. Of wrecking pumps they show one of 20" steam and 18" water cylinder with 24" stroke, capable of discharging 2,500 gallons per minute. Another of their specialties is the combined air and circulating pumps for steamships, the use of which, separate from the main propelling engines, is particularly advantageous in connection with the compound engine now so universally placed in seagoing steamers, the atmospheric back pressure being thereby relieved from the large low pressure piston at starting.

Oil line and other pumps for pumping against very heavy pressures are also a special manufacture with this company, several sizes of which were shown. Some of their productions in this line are now working against a head of 1,500 lbs. per square inch, oil pressure. They showed hydraulic pumps with proportions capable of producing a water pressure of 5,000 lbs. to the square inch. They have just produced a new annular compound steam pump for the more economical use of large water works than can be done with the ordinary type of direct acting pump.

In all their direct acting pumps there is the great advantage of short connections, giving an extremely short pump over all, for a given power. As an instance of this representative feature in their machines, I may instance one which was on exhibition of 36 inches stroke (piston pump), having but 3¼ inches between the stud bolts carrying the two opposite stuffing-box glands; as little as is possible to allow of the withdrawal of one of the glands for packing.

The valve gear is all of either steel or case-hardened low moor iron, and the tappet lever of this gear has an adjustable fulcrum which may be momentarily adjusted to produce the necessary variation in the cushioning of the piston for variation of lift. The steam valves and valve gear peculiar to the Blake Pump are ingenious in their simplicity: a combination of two valves, main and auxiliary, both of which are plain flat slides similar to that used in the ordinary steam engine. The main valve is driven by an ordinary piston with spring rings, and is therefore as positively moved as any steam piston with pressure upon it. The auxiliary valve receives impulse from the main piston, and is therefore as positively moved as by a metallic connection to a crank or eccentric. The auxiliary valve has three ports which virtually form an extension upward of the steam cylinder ports in any position, and on the upper side of this slides the main valve. If it were possible for the main piston to reach a velocity greater than the small piston which drives the main valve, the former would come in contact with the cylinder head; but this is rendered impossible by this auxiliary valve or movable seat having a direct connection with the steam piston, and acting to admit steam to cushion and reverse the pump independent of the action of the main valve. This important and ingenious arrangement permits of these pumps being run at high or variable speeds without danger



THE BLAKE SPECIAL MINING PUMP.

of the steam piston striking the cylinder heads, while at low speeds the piston will not stop so far short of the proper end of the stroke as to waste steam from excessive clearance. The arrangement of two flat valves, working one upon the other, and they upon a flat seat, constitutes an arrangement which must wear as well and evenly as the common three-ported steam engine slide valve. With this arrangement of valves, too, the sudden admission of the full boiler pressure to the steam piston at the end of the stroke is avoided; this admission being so gradual as to prevent any sudden jar, and giving ample time for the easy seating of the pump valves.

The first four figures show clearly the arrangement of the working parts, and the peculiar features of the valve gear. Fig. 1 gives a longitudinal vertical section through the whole machine. Fig. 2 is a similar section of the cylinder, within which works the auxiliary piston for moving the main valve; half through the live steam and half through the exhaust ports. Fig. 3 is a plan of the main cylinder valve seat, and Fig. 4 an isometrical view of the auxiliary valve. The arrangement of the pump valves are clearly shown in Fig. 1, two being off their seats, corresponding to the motion of the steam piston indicated by the arrow The curved top of the main steam valve, as seen in Fig. 1, lies in a neck turned in the center of the double auxiliary piston, so that while it can always adjust itself to its seat as it wears, it is as positively moved at all times.

As the main piston strikes the tappet rods which project through stuffing boxes into the main cylinder, the auxiliary valve is moved far enough to establish a small opening for the passage of steam to the main piston before it admits any behind one end of the auxiliary piston, thus giving what amounts to a steam lead which arrests the motion of the main piston, and prevents its contact with the cylinder head. On the exhaust side of the auxiliary valve, as shown in Fig. 4, are two slots which admit steam to one end of the auxiliary piston and establish communication between the other end and the main exhaust, alternating this operation for each stroke, and on the steam side in the same figure is a single slot, which permits of the passage of a small quantity of steam to the exhaust end of the auxiliary piston, just at the right time to arrest its motion and prevent its striking the cylinder head just as in the main cylinder. This system of valve gear is certainly most simple and ingenious, and so perfectly does it operate that the pump cannot be stopped in a position in which it will not again start as soon as the stop valve is opened.

The exceedingly great range of speeds at which this valve gear permits the pump to be driven is something unprecedented. In experiments made at the works of the Messrs. S Owens & Co., London, a 5-inch pump, with 8-inch steam cylinder and 12 inches stroke, ran smoothly and equably at speeds ranging from 155 to 25 strokes per minute; and with the head increased, by throttling the delivery, up to that of 230 feet, and with a steam pressure of about 40 lbs., it ran perfectly at the rate of five strokes per hour, or one stroke in twelve minutes, thus working from a piston speed of 155 feet down to one inch per minute, while delivering the water continuously. At the same time experiments were had to test the working of the pump under sudden variations of load, with equally satisfactory results. The estimation in which these pumps are held in Europe, as well as in this country, is shown in the fact that the London firm above mentioned have introduced and are now manufacturing them for the European market; and there can be little doubt but that the magnificent display made by the Blake Company at the Centennial will largely increase the interest with which engineers from all parts of the world will regard their machines. J. T. H.

CORRECTION.

IN the article on water-wheel tests, in our issue No. 61, the several typographical errors in the formulæ and tabular statement escaped the notice of the proof-reader. From equations 1 to 6 the reading should be as follows:

$$F = C\sqrt{h^3}(L - \tfrac{3}{10}h) \quad \ldots\ldots 1$$

$$f = C\sqrt{h_1^3}(L - \tfrac{3}{10}h_1) \quad \ldots\ldots 2$$

Or substituting for $C\sqrt{h^3}$ and $C\sqrt{h_1^3}$ the values given in Francis' table, and calling them respectively V and v, we have

$$F = V(L - \tfrac{3}{10}h) \quad \ldots\ldots 3$$

$$f = v(L - \tfrac{3}{10}h_1) \quad \ldots\ldots 4$$

and for the horse power of the water:

$$HP^1 = \frac{WH[V(L - \frac{3}{10}h) - v(L - \frac{3}{10}h_1)]}{550} \quad \ldots\ldots 5$$

and

$$P = \frac{55000\ HP}{[V(L - \frac{3}{10}h) - v(L - \frac{3}{10}h_1)]} = \frac{100\ HP}{HP^1} \quad \ldots\ldots 6$$

In column 7 of the table, for *PP* read *HP*, and in column 9, for h_1 read h. Also, on page 965, referring to Fig. 33, for *parols* read *panels*. EDS.

FILES VERSUS EMERY WHEELS AND MILLING TOOLS.

By JOSHUA ROSE.

MOST of the foreign engineers and correspondents who visited the Centennial Exhibition were very much impressed with the American system of mechanical manipulation by special tools and machines, and many of them are ventilating the subject in Europe with a view of inducing there the adoption of similar systems to their manufactures. That some of these gentlemen should fall into error on some points is not to be wondered at, in view of the fact that literary and mechanical manipulative pursuits are somewhat wide apart, and hence an expert at the one can scarcely be expected to be also an expert at the other. Thus the correspondent of the London *Times*, recently discoursing upon the wide range of uses to which emery wheels are put in the United States, says that "The chisel and the file are in danger of elimination from the workshop for the majority of purposes for which they are now employed." Now this statement is far from being warranted by the facts of the case. The uses to which emery wheels are chiefly put are: To remove surface skin preparatory to polishing. To cut materials too hard to be cut by ordinary tools, and to perform tedious operations upon small work. With reference to the first, the emery wheel must be conceded to have succeeded the file and also the fast running grindstone, to which such work was usually assigned, and to which it more properly belonged; for the application of the file upon such work was only permissable in the absence of a fast running stone or of a covered emery wheel. The file is too delicate and costly a tool for such uses, providing a substitute was at hand.

Before proceeding further, however, it may be as well to point out that the term "emery wheel" includes two distinct classes of wheels. The emery wheel is a wooden wheel covered with a leather band to which emery is attached by means of glue, and this is the form which is, at the present day, in a large majority of cases, in use for polishing purposes. Wheels of this class have been in operation for many years both in England and the United States. With coarse emery applied, they may be used to remove hard skin and prepare the surface for polishing upon a wheel having still finer emery. If, however, a very fine polish is required, the wheel is covered with very fine emery, and then the latter is worn down to a glazed surface by the application of a little oil or grease and a piece of metal. In this form it is called the "glazing wheel." If, however, a superfine polish is required, the emery wheel in any form is inadequate to the task, and buff wheels of walrus hide, cloth or rags, supplied with rouge, crocus, or Vienna lime, are brought into requisition. Now, for all the above purposes, the file is not and has not been, for many years past, used in either of the two countries, except it be in some isolated case, and in the absence of the above wheels.

The solid emery wheel is composed of emery cemented together by a suitable cement and compressed under enormous pressure, and this is the class of wheel which is of American origin, and which has found many fields of usefulness. It cannot, however, be said to have encroached upon the legitimate field of usefulness of the file, as we shall presently see. The large sizes of these wheels are used upon work for which the fast running grindstones have long been employed, and these latter for many purposes still hold their own. The cases wherein large emery wheels have proved superior are those in which, from the nature of the work, the operations of the grindstone would be hidden from view. Suppose, for instance, we have the surface of a plate of iron to grind, as is required in locomotive tender and in safe manufacture. The weight of the stone, the necessity of using water and other elements, would render it out of the question to swing the grindstone in a frame and travel it over the surface of the plate. This, however, may be very easily accomplished with a large emery wheel, its abrasive deficiencies, as compared with the stone, being more than compensated for by the enormous speed at which it may be revolved. For such work as this the solid emery wheel stands unrivalled.

As an example of application to hard metals, we may instance the saw gummer and sharpener, an excellent specimen of which was exhibited in operation at the Centennial. Here the emery wheel may be justly said to have encroached upon the domain of the file; but even in this connection it is well to remember that it is unfair to apply a file to hardened or tempered steel, and such duty can scarcely be included in the legitimate field of application of the file, and therefore the latter has gained rather than lost by the change. This change, however, though undoubtedly destined to become almost universal, is not as yet all in favor of the emery wheel, for while fine toothed saws, such as handsaws, are still sharpened by the file, even saw gummers do not always include emery wheels; indeed, if we inspect the catalogue of even so large a firm as Henry Disston & Sons, of Philadelphia, we shall find therein three saw gummers with cutters to two having emery wheels, and we shall find in the same catalogue the following: "We have at this time over one hundred hands daily employed in filing saws, each hand consuming or wearing out from six to twelve files per day." This is indeed instructive, for in the absence of steam power we might expect to find the file and to miss the emery wheel, but this firm, which use from 600 to 1,200 saw files per day, is probably the largest and best known saw manufactory in the United States. In this connection, it may also be remarked, that the only file-testing machine exhibited at the Centennial was engaged mainly testing mill files for saw-sharpening purposes—not, be it noted, upon small three-cornered files, but upon 10 and 12 inch mill files. In the list of saw files contained in the above named catalogue we find pit saw files from 5 to 11 inches long; round files up to 13 inches long; half rounds up to 9 inches, and mill files up to 14 inches long, while more than half those on the list are files too large for use upon fine toothed saws. *Engineering* remarks, that "In the use of cast iron stoves and in the manufacture of steel plows, the solid emery wheel finds a demand in the United States that has no parallel in England." This is true enough, but in this field the solid emery wheel is simply an improvement on the fast running grindstone, and in no way an interference with the file. So, likewise, for trimming castings or removing excrescences upon the same, for fitting the edges of plates or castings, the emery wheel must displace the grindstone or the file. But for getting up plane surfaces, such as are usually got up by the planing or shaping machine, the emery wheel is altogether inadequate, both on account of cost and quality of duty; nor is it practicable upon such work to dispense with the use of the file if really good work is required. In fact, the only field of usefulness in this direction to which the emery wheel can be successfully applied is upon metals too hard to be cut by ordinary tools, and this description of work does not compose one-twentieth of one per cent. of the work usually, even in years gone by, given to the planer or shaper. And as to the file—neither the planer, the shaper, nor the emery wheel, can perform their duties (upon such work as is usually assigned to the shaper or planer) sufficiently true for good work. And it is the file upon which we must depend for accuracy in work of this kind. The emery wheel, indeed, is rarely used as a finishing tool even upon fine work. Thus at the Centennial we found it in the watchmaking processes employed simply as a means of keeping a square corner upon the polishing wheel, by grinding its periphery and side face. In the needle-making processes emery wheels were, it is true, employed to reduce and point the needles, a duty which has always been assigned to abrasive tools.

Emery wheels are very useful tools to the vice hand or fitter for roughing down some kinds of work, but in no case can they be relied upon for accuracy, notwithstanding the opinion of an eminent English authority to the contrary. And if the English ever expect to become satisfied with emery wheel work (for any except work of small size), they must abandon the use of the surface plate, because it tells too many tales. And here be it noted that, on small work, even the milling tool is, for the production of flat tree surfaces, far preferable to the emery wheel unless the hard skin only of the metal is to be removed. Emery belts and emery wheels are for brass finishing, for the manufacture of small and intricate articles, such as saddlery and ironmongers' ware, invaluable, and for such purposes must entirely supplant all other tools; but, so far as the machinist is concerned, an emery wheel, though a good rough assistant, can never be more than that upon accurate work. Even milling tools, except for small special work, will not produce surfaces sufficiently true for the repair work of locomotives as practised in some, at least, of the English workshops. It is indeed safe to predict that progress in the United States will for some time lie more in the path of producing better work with our present special tools than in that of designing new ones.

Upon cylindrical work, requiring great accuracy, the emery wheel, or, what is better, the corundum wheel, may be used to follow after the turning tool with great advantage. For sharpening hardened tools such as milling cutters, the emery wheel is an excellent tools, and occupies the position as does the file to hardened saw blades, that is to say, it is the best tool we have for the work, but is, at the same time, far from what is actually required, and the reason lies upon the surface. Suppose, for instance, that we are sharpening teeth upon the circumference of a cutter, if the plane in which the wheel revolves is in line with the plane of the length of the teeth, the edge of the latter will wear a groove in the wheel, which will, in consequence, grind off the sharp edge of the teeth. In consequence of this fact, the wheels are often placed aslant to the plane of the length of the tooth, and sometimes indeed, at a right angle to it, and the result in either case is that the back of the tooth is shaped hollow instead of being rounded, and hence the cutting edge is not well supported by the metal immediately behind it, and therefore soon becomes dull. The shape of the teeth is in fact not the most desirable one. Upon large work this fact assumes very great importance, but on small work the case is entirely different; and it may truthfully be said that a very large quantity of well finished small work may be done by the use of milling tools, and that the average of such work is more accurately made and better finished than if it were made by hand; but, nevertheless, I have never yet seen the piece of machine work that could not be improved by the addition of hand work. Furthermore, I venture to assert that neither by the use of emery wheels nor of milling tools can wrought iron, cast iron, or steel surfaces, say 8 inches by 6 inches, be made so flat but what it will take ten minutes *hard work* with a 10-inch flat dead smooth file to make them stand a test of their truth. In all cases where a surface is subject to wear, truth is an element of the greatest consequence, because the pressure due to the duty being constant the wear will take place, as regards time, in proportion to the area of metal in contact. It must be borne in mind that the area of working surfaces is proportioned more to obtain wearing qualifications than with a view to be merely strong enough, and if the surface provided is not in actual working contact it is of but little avail. On the other hand, however, if a comparatively small amount of the area only is in working contact, the pressure intended to be distributed over the whole area is concentrated upon the small one, and hence, instead of its wearing smoothly, it abrades or cuts, very finely, it may be, but the destruction takes place much more rapidly than it should do. The difference between a well planed ground or milled flat surface of any size, and that of a similar surface properly trued with a file, may not be perceptible to the ordinary or inexperienced eye, but it is a very great deal more than is commonly supposed, even in machine shops where the truth is not tested.

BESSEMER STEEL MANUFACTURE IN AMERICA.

To the Editor of *Engineering:*

SIR,—The letter of Mr. Gmelin, which appeared in the last number of your valuable paper, and his remark therein "that there are now in Germany far too many steel works for the wants of the country," induces me to give you some details about the Bessemer steel manufacture in Germany, which may be interesting for your readers. These details are taken from a report of Mr. A. Brauns, managing director of the Georgs-Marien Works, near Osnabrück, in which report he draws a comparison between the American Bessemer steel manufacture and the same branch of manufacture in his country.

Mr. Brauns, in enumerating fourteen Bessemer works now existing in Prussia, makes out that in 1875 they had at work 32 converters out of 61 converters all fully equipped and in working order. These 32 converters produced, in 1875, 236,000 tons of Bessemer steel, equal on an average to 74,000 tons per annum for every converter at work, which represents about a third of the production of an American converter during the same period of time.

This enormous difference in production, however, is stated not to be due to an incapacity of the Germans to keep pace with the Americans, but owing simply to circumstances, viz., that in Germany they cannot obtain sufficient work to keep their plant fully employed, and are compelled to lessen their production as much as they can only to keep their works going. About half their plant standing idle, and, so to say, in reserve for an emergency, they worked with the other half intermittently, barely sufficient to keep their staff of efficient workmen together. Some works are reported to have had their working hours from 6 A.M. to 6 P.M.; others to have worked only four days in a week, and whereas all of them could raise their production to 20 or 26 heats of 5 tons each per converter for 24 hours a day, they were contented to have done 6 to 7 heats for 12 hours a day, and they found this, with the reduced employment of their plant, quite sufficient for their requirements.

Thus reads the description of the state of affairs in Prussia during the year 1875, and from all reports received it appears that things have not mended much since. Saxony, Bavaria, and Alsace-Lorraine are, as reported by Mr. Brauns, in the same predicament.

I remain, Sir, yours respectfully,

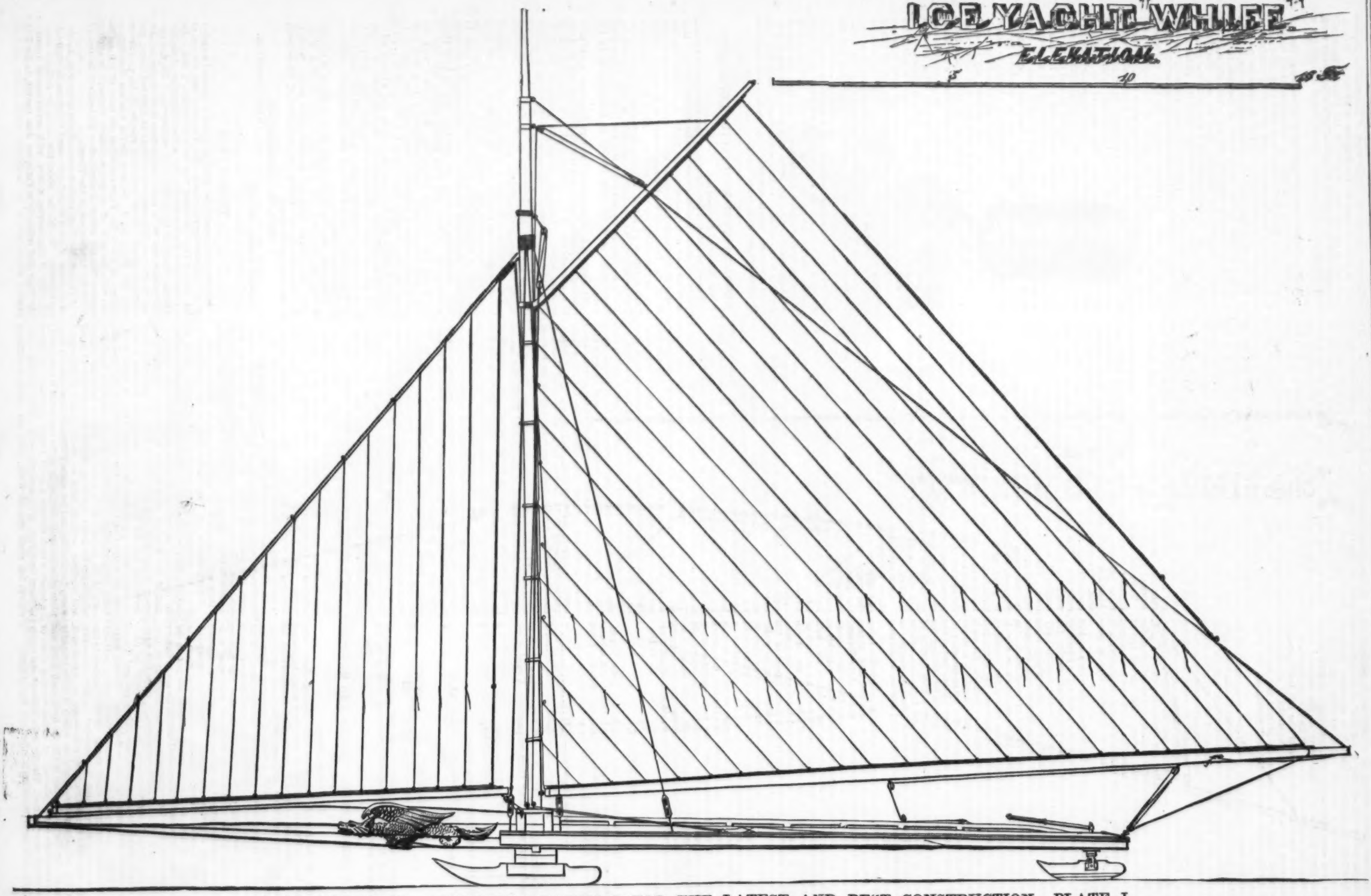
KARL BERGMANN.

London, January 22, 1877.

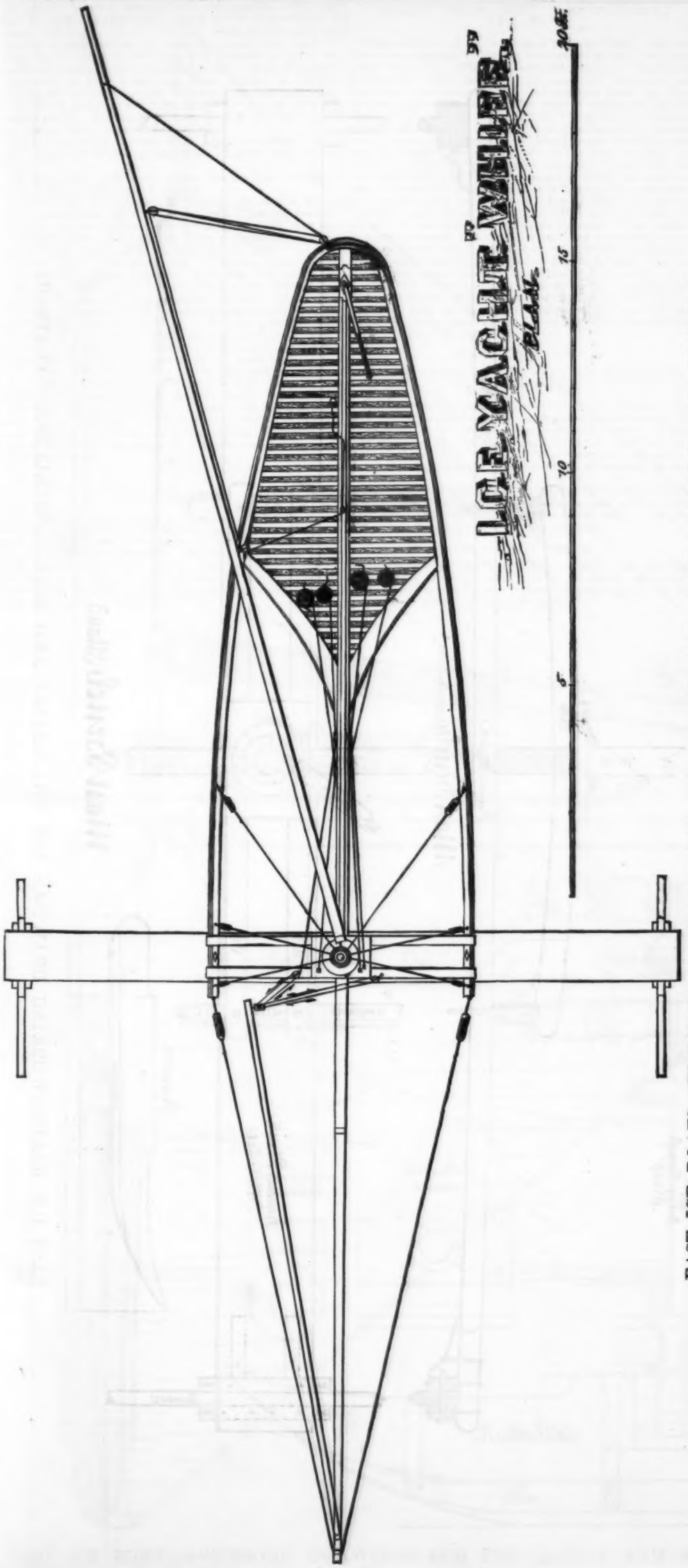
THOMAS PAGE.

WE regret to record the death of another eminent member of the engineering profession. Mr. Thomas Page, the son of Mr. Robert Page, solicitor, was born in London in 1803. He was educated for sea service, but at the suggestion of the late Thomas Tredgold he studied civil engineering. His first employment seems to be as a draughtsman in an engine works, but he afterwards became an assistant of Edward Blore, the Gothic architect. Some excellent results of his experience with Mr. Blore are to be seen in the Chelsea Suspension Bridge, in which Mr. Page combined the taste of the architect with the skill of an accomplished engineer in such a manner that the bridge is admitted on all hands to be one of if not the handsomest on the Thames.

Although Mr. Page made no remarkable inventions, he was an engineer of great ability and sound judgment in engineering matters. To this he added the talent for æsthetic combination of engineering utility with architectural beauty. Mr. Page died suddenly in Paris, on Jan. the 8th, in his 74th year.



FAST ICE BOATS.—WORKING DRAWINGS FOR THE LATEST AND BEST CONSTRUCTION.—PLATE I.



FAST ICE BOATS.—WORKING DRAWINGS FOR THE LATEST AND BEST CONSTRUCTION.—PLATE II.

FAST ICE YACHTS.

IN Machinery Hall, at the Centennial Exhibition, was exhibited a beautifully finished full rigged ice yacht, which attracted a good deal of attention, both on account of its handsome and shipshape appearance, as well as from the natural curiosity of people in general to examine anything which brings them face to face with the realities of a pursuit which, to the masses, is as mysterious, and practically unknown, as the art of ballooning.

The "Whiff" was exhibited by her owner, Commodore Irving Grinnell, of the New Hampshire Ice Yacht Club, of New Hamburgh, Dutchess Co., New York. She is sloop rigged, forty feet in length, from the tip of her bowsprit to the end of her main boom; carries an area of sail of 347 square feet; and is one of the yachts of the second class, belonging to the above club. The club is composed of seven first-class yachts, measuring each not less than 550 sq. ft. of canvass, and carrying a total sail area of 3,292 sq. feet. The largest yacht, the "Flying Cloud," owned also by Mr. Grinnell, is sloop rigged, 53 ft. from out to out, and carries 620 sq. ft. of sail. There are six yachts of the second class, measuring less than 350 sq. ft. of canvass, the six carrying a total sail area of 1,646 sq. ft.; the largest yacht of this class being the "Whiff."

From the topmast of the "Whiff" at the Centennial hung the challenge pennant of America, now held by the New Hamburgh Yacht Club, and held open to competition for its possession by all ice yacht clubs of America and Europe. According to the conditions, the flag is always to be considered as a challenge flag, and never to become the individual property of any club winning it. The pennant is of silk, 30 ft. in length, and bears the words, "Ice Yacht Challenge Pennant of America."

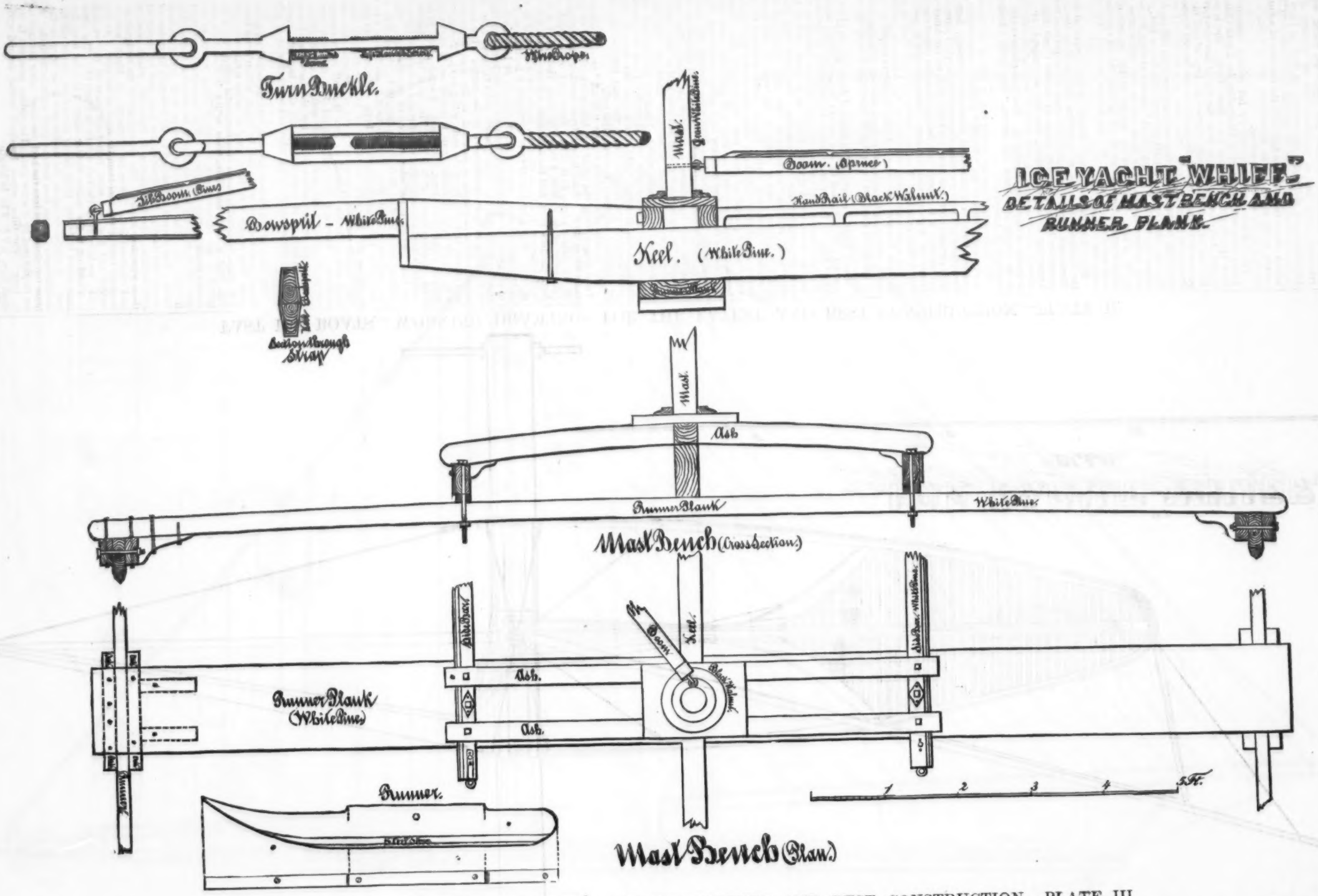
We understand from the owner that a full set of detailed working drawings of the "Whiff," similar to those which we publish, through Commodore Grinnell's courtesy, have at the request of the Norwegian Commission to the Centennial been prepared for them, and ice boats built on the American pattern will, it is hoped, soon become familiar objects on the fjords of Norway and Sweden. Russia would do well to follow the example of Norway, as the ice boats there in use present a strong contrast to those of the American pattern, much in favor of the latter. Arctic explorers might in this find a substitute for exhausted dogs, and the shipping trade of the North need not be so rigidly frozen up as it always has been.

The "Whiff," of which full detailed drawings are given in plates I., II., III., and IV., is, as will be seen, sloop rigged. The "hull," if it may be so called, is composed of the keel, or center timber, and two curved side timbers, joined at the mast by two curved timbers bolted on to them, and at the stern by a semicircular continuation. The mast rises from the "keel" and the "mast bench," the chief timber of the latter being the runner plank, at the ends of which two "runners" are bolted. This runner plank is bolted to the under side of the "side bars," and runs under the "keel." The "hull" proper of the boat commences the "mast bench," extending over less than half its width, and runs back in the form of an ordinary boat to the rudder end. The keel extends from here to a little ways beyond the mast, where the bowsprit is strapped on to it; and extending out forms the only hull timber in front of the mast. The deck occupies the hinder part of and less than half of the "hull." The rudder consists of a movable skate or "runner," worked as in an ordinary vessel. The mast and bowsprit are very rigidly stayed by wire rope shrouds. From the general design, down to every detail, the object has been to give great strength and rigidity with the least possible amount of timbering necessary to secure this end.

The general dimensions of the "Whiff" are as follows: Total length, from the tip of her bowsprit to the end of the main boom, 40 ft. Total height, from masthead to the plane of the runner edges, 25 ft. 3 in. From end of bowsprit to extremity of deck, 31 ft. 4 in. The mast rises 21 ft. 4 in. from the deck level, and has a topmast which extends 3 ft. 8 in. further up; is 4 in. in diameter at the bottom, and 3 in. at the top. The bowsprit is 15 ft. in length, 3 in. deep at the ends, curving to 6 in. where it is strapped by an iron band on to the keel. It is additionally secured to the keel by a bolt running through both. The jibsprit is 13 ft. long, 2 in. at ends, rising to 2½ in. in diameter at the centre. The main boom is 24 ft. in length, is fastened to the mast by an eye and staple, and is 2½ in. at the ends, rising to 4½. The gaff is 9 ft. long, 2 in. in diameter, and is jawed on to the mast. Runner plank, 16 ft. long, 1 ft. wide. Runners, 4 ft. 10 in. long. Rudder skate, 2 ft. 5 in. The deck is of narrow, closely jointed alternate slips of cedar and spruce, laid across the boat, and 5½ inches below the top of the side bars. The mainsail has a hoist of 13 ft. 8 in.; foot, 23 ft.; head, 8 ft. 4 in.; and leach, 24 ft. 3 in. The jib has a hoist of 14 ft. 8 in.; foot, 12 ft. 7 in.; and leach, 19 ft. 10 in. The total sail area is 347 sq. ft. The sails are made of heavier canvass than that usually used for a seagoing yacht of the same size, and each strip is double bighted to give the sail the necessary stiffness. The mast, bowsprit, jibsprit, keel, side bars, runner plank, are of white pine. Boom and gaff are of spruce. The curved timbers which brace the side bars are of ash. The handrail is of walnut, and the side bars are cased with the same wood, being also ornamented with a gilt beading.

The shoes of the runners are cast, and are bolted on to the skates, which are of white oak, by means of four screw bolts each. This runner, 4 ft. 10 in. long, as before mentioned, and 7 in. high, is bolted between two horizontal oaken bars, 1 ft. 7 in. long, 4½ deep, and 2½ in. wide, which, in their turn, are bolted to the runner plank, the whole being braced to the runner plank by two side pieces. The bowsprit is strapped and bolted on to the keel as shown in elevation and section in Plate III. The iron strap is 2 in. wide and ¼ an inch thick. The jibsprit is fastened to the bowsprit by means of an eye and staple. The shrouds are kept taut by means of turn buckles, like that shown in Plate III., which connect them with their staples. The shrouds are of the best galvanized charcoal iron, 7-16 in. in diameter. A black walnut handrail runs on the keel from the mast to the tiller. As the rudder and post are most important parts of the yacht's build, we have given the full details in Plate IV. The shoe is bolted on to the oaken rudder skate, 2 ft. 5 in. long, by three screw bolts, the latter being pinned on to the rudder post. A rubber spring on the rudder post is set between the shoulder and the cast iron bottom plate let into the deck. A brass top plate is let into the keel, the tiller being fastened to the rudder post by a screw nut. The rudder post is 1 ft. 3½ in. long. The tiller, whose handle is bound around with small rope, is 2 ft. 6 in. in length.

The rudder shoes, as well as those of the two runners, are of cast iron. Steel has been tried, but was found to be too hard. For if the ice be smooth, and free from snow, etc.,



ICE YACHT "WHIFF."
DETAILS OF MAST BENCH AND RUNNER PLANK.

FAST ICE BOATS.—WORKING DRAWINGS FOR THE LATEST AND BEST CONSTRUCTION.—PLATE III.

the greater speed is obtained with sharp skates. They are filed so sharp that they cause a hand nail to fluff when it is drawn over them. On the contrary, when there is snow ice, ice with a rough surface or partially covered with snow, or when the weather is moderate and disposed to thaw, the yacht sails much faster with slightly dulled shoes. The shoes, sharpened up with a file, can, when desired, be quickly roughened with emery paper. If the edges need sharpening, a fine file or an oil stone will accomplish in a short time the desired result. Steel shoes would not allow of these sudden transitions, while those of cast iron do.

All the iron work on the "Whiff" is nickel plated, and a high degree of finish is observable on every part of the vessel.

When sailing, a sail-shelter from the wind is erected at the fore part of the deck, if desired.

The "Whiff" is ornamented with a very artistic figure-head, representing a griffin. Being built of the best possible material, and elaborately gotten up, this ice yacht cost her owner $700, but a boat equally good, without the same degree of finish, can be built for from $350 to $400.

A cat rigged ice yacht, the "Flyaway," was lately built by Commodore Grinnell. She was not tried last season on account of the weather being unfavorable to ice yachting, but great speed is expected from her. She is of a very long and narrow build, her side pieces continuing until they intersect the keel at the bow. The mast is stepped two feet forward of the runner plank, and the boom projects but two feet over the stern. Extreme length, 25 ft.; width of runner plank, 15 ft. 6 in.; boom, 24 ft.; gaff, 9 ft. 6 in.; hoist, 17 ft. The "Flyaway" carries 342 square feet of canvass. She is expected to prove superior to sloop rigged yachts, especially in beating to the windward.

We have taken a good deal of pains with this article in order to give drawings in such detail, and with such careful accompanying descriptions, as will enable any of our readers to construct similar ice boats for themselves or others upon any required scale.

FAST STEAMER.

M. GIFFARD, the celebrated aeronaut, and inventor of the *injecteur*, is constructing, at Forges-de-la-Seine, a small steamboat for service from Pont Royal to the Exhibition (1878) Pier, distance only three miles. The steamer will realize the extraordinary velocity of forty-five miles per hour, and run the distance in four or five minutes. The length of the steamer will be thirty metres, and transverse section three and a half metres.—*Nature.*

THAMES STEAM FERRY COMPANY'S BOAT "PEARL."

THE official trial of the second boat, the Pearl, built for the above company by Messrs. Edwards & Symes, took place lately at London. The boat steamed alongside Greenwich Pier at one o'clock, and took on board the chairman and directors of the company, and then steamed down the river at about eight miles an hour, the engines making 38 revolutions per minute. At Woolwich the vessel was put through some remarkable evolutions for such an unwieldy looking craft, to the astonishment of the passengers on board the London Steamboat Company's boats which were passing; the order was given for the boat to complete a circle with the helm hard over, and both engines going ahead, this was accomplished in two minutes in a circle of about 80 yards diameter round a barge in the stream; then the helm was placed amidships, and one engine stopped, when the circle was completed in 2½ minutes, about 90 yards diameter. The engines were then stopped, one started ahead and one astern, when the boat turned round on her own center, with no perceptible motion ahead or astern, except that due to the tide. The engines being again reversed the boat stopped at once. Considering the form of the vessel, these results proved to the entire satisfaction of all present that the captain had full control of the boat, and that in any emergency, when on her station at Wapping, there would not be the least doubt of her being handled with certainty.

OFFICIAL RULES FOR SIGNALS ON STEAM AND SAILING VESSELS.

THE Treasury Department, under date of February 17, 1877, has issued the following instructions to be observed in the navigation of vessels of the mercantile marine of the United States; and, by the provisions of the Revised Statutes, the following rules, from one to twenty-four, inclusive, are made applicable to the navigation of vessels of the navy.

Every vessel of the mercantile marine navigated, without complying with the instructions of this circular, will be liable to a penalty of two hundred dollars, for which sum the vessel may be seized and proceeded against.

STEAM AND SAIL VESSELS.

RULE 1. Every steam vessel which is under sail and not under steam, shall be considered a sail vessel; and every steam vessel which is under steam, whether under sail or not, shall be considered a steam vessel.

LIGHTS.

RULE 2. The lights mentioned in the following rules, and no others, shall be carried in all weathers between sunset and sunrise.

Lights for Ocean-going Steamers and Steamers carrying Sail.

RULE 3. All ocean-going steamers, and steamers carrying sail, shall, when under way, carry:

(*a.*) At the foremast head, a bright white light, of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least five miles, and so constructed as to show a uniform and unbroken light over an arc of the horizon of twenty points of the compass, and so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side.

(*b.*) On the starboard side, a green light, of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles, and so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, and so fixed as to throw the light from right ahead to two points abaft the beam on starboard side.

(*c.*) On the port side, a red light, of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles, and so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, and so fixed as to throw the light from right ahead to two points abaft the beam on her port side.

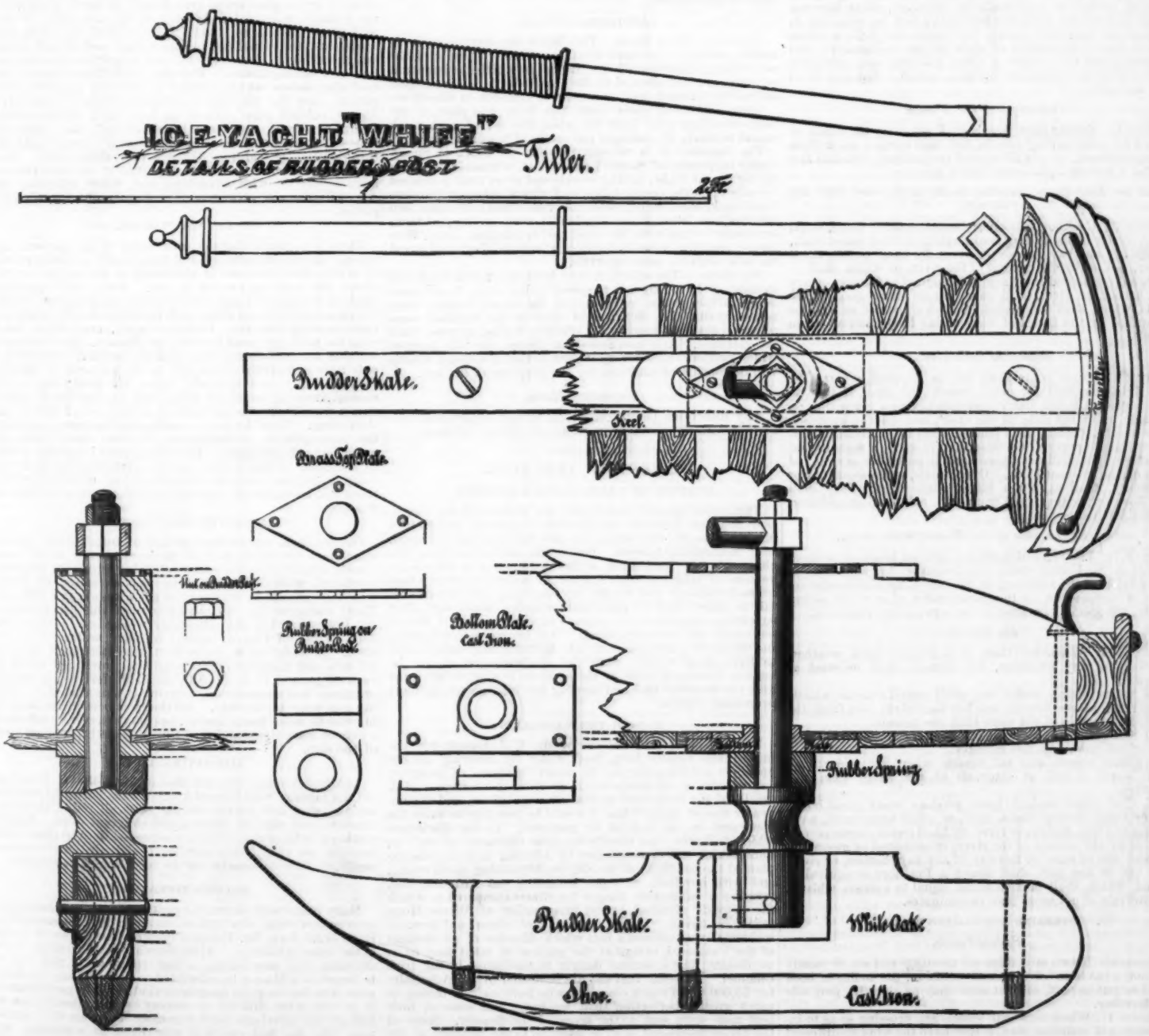
The green and red lights shall be fitted with inboard screens, projecting at least three feet forward from the lights, so as to prevent them from being seen across the bow.

Lights for Towing Steamers.

RULE 4. Steam vessels, when towing other vessels, shall carry two bright white masthead lights, vertically, in addition to their side lights, so as to distinguish them from other steam vessels. Each of these masthead lights shall be of the same character and construction as the masthead lights prescribed by Rule 3.

Lights for Steamers not Ocean-going nor carrying Sail.

RULE 5. All steam vessels other than ocean-going steamers and steamers carrying sail, shall, when under way, carry on the starboard and port sides lights of the same character and construction and in the same position as are prescribed for side lights by Rule 3, except in the case provided in Rule 6.



FAST ICE BOATS.—WORKING DRAWINGS FOR THE LATEST AND BEST CONSTRUCTION.—PLATE IV.

Lights for Steamers on the Mississippi River.

RULE 6. River steamers, navigating waters flowing in the Gulf of Mexico and their tributaries, shall carry the following lights, namely: One red light on the outboard side of the port smoke pipe, and 1 green light on the outboard side of the starboard smoke pipe. Such lights shall show both forward and abeam on their respective sides.

Lights for Coasting Steam Vessels, and Steam Vessels navigating Bays, Lakes, and Rivers.

RULE 7. All coasting steam vessels and steam vessels other than ferry boats, and vessels otherwise expressly provided for, navigating the bays, lakes, rivers, or other inland waters of the United States, except those mentioned in Rule 6, shall carry the red and green lights, as prescribed for ocean-going steamers, and in addition thereto a central range of two white lights; the after light being carried at an elevation of at least fifteen feet above the light at the head of the vessel. The head light shall be so constructed as to show a good light through twenty points of the compass, namely: From right ahead to two points abaft the beam, on either side of the vessel, and the after light, so as to show all around the horizon.

The Lights for Ferry Boats

Shall be regulated by such rules as the Board of Supervising Inspectors of Steam Vessels shall prescribe. (See additional rules below.)

Lights for Sailing Vessels.

RULE 8. Sail vessels, under way or being towed, shall carry the same lights as steam vessels under way, with the exception of the white masthead light, which they shall never carry. (See Rule 3, *b* and *c*.)

Exceptional Lights for Small Sailing Vessels.

RULE 9. Whenever, as in case of small vessels during bad weather, the green and red lights cannot be fixed, these lights shall be kept on deck, on their respective sides of the vessels, ready for instant exhibition, and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such a manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side. To make the use of these portable lights more certain and easy, they shall each be painted outside with the color of the light they respectively contain, and shall be provided with suitable screens.

Lights for Steam Vessels and Sailing Vessels at Anchor.

RULE 10. All vessels, whether steam vessels or sail vessels, when at anchor in roadsteads or fairways, shall, between sunset and sunrise, exhibit where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light in a globular lantern of eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light, visible all around the horizon, and at a distance of at least one mile.

Lights for Pilot Vessels.

RULE 11. Sailing pilot vessels shall not carry the lights required for other sailing vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light every fifteen minutes.

Lights for Coal Boats, Trading Boats, Rafts, and other like Craft.

RULE 12. Coal boats, trading boats, produce boats, canal boats, oyster boats, fishing boats, rafts, or other water craft, navigating any bay, harbor or river, by hand power, horse power, sail, or by the current of the river, or which shall be anchored or moored in or near the channel or fairway of any bay, harbor, or river, shall carry one or more good white lights, which shall be placed in such a manner as shall be prescribed by the Board of Supervising Inspectors of steam vessels.

Lights for Open Boats.

RULE 13. Open boats shall not be required to carry the side lights required for other vessels, but shall, if they do not carry such lights, carry a lantern having a green slide on one side and a red slide on the other, and, on the approach of or to other vessels, such lantern shall be exhibited in sufficient time to prevent collision, and in such a manner that the green light shall not be seen on the port side nor the red light on the starboard side. Open boats, when at anchor or stationary, shall exhibit a bright white light. They shall not, however, be prevented from using a flare-up, in addition, if considered expedient.

Lights on Vessels of the United States Navy.

RULE 14. The exhibition of any light on board of a vessel of war of the United States may be suspended whenever, in the opinion of the Secretary of the Navy, the commander-in-chief of a squadron, or the commander of a vessel acting singly, the special character of the service may require it.

Fog Signals.

RULE 15. Whenever there is a fog or thick weather, whether by day or night, fog signals shall be used as follows:

(*a*) Steam vessels under way shall sound a steam whistle placed before the funnel, not less than eight feet from the deck, at intervals of not more than one minute.

(*b*) Sail vessels under way shall sound a fog horn at intervals of not more than five minutes.

(*c*) Steam vessels and sail vessels, when not under way, shall sound a bell at intervals of not more than five minutes.

(*d*) Coal boats, trading boats, produce boats, canal boats, oyster boats, fishing boats, rafts, or other water craft, navigating any bay, harbor, or river by hand power, horse power, sail, or by the current of the river, or anchored or moored in or near the channel or fairway of any bay, harbor, or river, and not in any port, shall sound a fog horn or equivalent signal, which shall make a sound equal to a steam whistle, at intervals of not more than two minutes.

STEERING AND SAILING RULES.

Sailing Vessels.

RULE 16. If two sail ships are meeting end on, or nearly end on, so as to involve risk of collision, the helms of both shall be put to port, so that each may pass on the port side of the other.

RULE 17. When two sail vessels are crossing so as to involve risk of collision, then, if they have the wind on different sides, the vessel with the wind on the port side shall keep out of the way of the vessel with the wind on the starboard side, except in the case in which the vessel with the wind on the port side is close hauled and the other vessel free, in which case the latter shall keep out of the way. But if they have the wind on the same side, or if one of them has the wind aft, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

Steam Vessels Meeting.

RULE 18. If two vessels under steam are meeting end on, or nearly end on, so as to involve risk of collision, the helms of both shall be put to port, so that each may part on the port side of the other.

RULE 19. If two vessels under steam are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

Sail and Steam Vessels Meeting.

RULE 20. If two vessels, one of which is a sail vessel and the other a steam vessel, are proceeding in such directions as to involve risk of collision, the steam vessel shall keep out of the way of the sail vessel.

Steam Vessel Approaching another Vessel or in a Fog.

RULE 21. Every steam vessel, when approaching another vessel, so as to involve risk of collision, shall slacken her speed, or, if necessary, stop and reverse; and every steam vessel shall, when in a fog, go at a moderate speed.

Vessel overtaking another.

RULE 22. Every vessel overtaking another vessel shall keep out of the way of the last mentioned vessel.

RULE 23. Where, by rules, seventeen, nineteen, twenty, and twenty-two, one of two vessels shall keep out of the way, the other shall keep her course, subject to the qualifications of Rule twenty-four.

SPECIAL INSTRUCTIONS.

RULE 24. In construing and obeying these rules, due regard must be had to all dangers of navigation, and to any special circumstances which may exist in any particular case rendering a departure from them necessary, in order to avoid immediate danger.

Sailing Vessels to be furnished with Signal Lights, and to show Torches.

RULE 25. Collectors or other chief officers of the customs shall require all sail vessels to be furnished with proper signal lights; and every such vessel shall, on the approach of any steam vessel during the night time, show a lighted torch upon that point or quarter to which such steam vessel shall be approaching.

ADDITIONAL RULES.

Lights for Ferry Boats.—The lights for ferry boats with rudders on both ends shall be such as, in the opinion of the supervising inspector of the district in which the boats are running, are best adapted to the character of the navigation and to the prevention of accidents by collision or otherwise.

Globe Lights.—A globe light may be used in place of the torch mentioned in Rule 25, when the use of such torch would be likely to endanger the safety of vessel or cargo.

Fog Signals.—It is recommended by the Board of Supervising Inspectors of Steam Vessels that, whenever there is a fog by day or night, sailing vessels and every craft propelled by sails upon the ocean, lakes, and rivers, when on the starboard tack, shall sound, with intervals of not more than two minutes, *one* blast of the fog horn; when on the port tack, *two* blasts; when with the wind free or running large, *three* blasts; and that, when lying-to or at anchor, they shall sound the bell, with the same intervals.

Fog Horns.—The selection of an instrument to be employed in making the fog signals required by law must in all cases be left to the master or owner of the vessel, it being only necessary that this department shall so far regulate such selection that instruments not effective for the purpose shall be excluded. Any instrument or device for this purpose which produces a sound equivalent to that of a steam whistle will be considered sufficient for the purposes of the law.

Conflicting Rules.

Any directions heretofore given by the department conflicting with the above instructions are hereby revoked.

INVENTORS' INSTITUTE.

EXHIBITS OF NAUTICAL IMPROVEMENTS.

THE recent opening meeting of the session of the Inventors' Institute, London, was devoted to matters, which, to a maritime people, now doing the carrying trade of the world, is of incalculable interest. One of the useful functions discharged by the institution is the opportunity it affords inventors of bringing their inventions before *confrères* whose trained intellects and kindly but searching criticisms never fail to detect and to point out crudities, while very often supplying suggestions on points which have escaped the attention of the inventor himself. Any invention which passes the ordeal of a discussion at this institute may safely claim to have great merit; while the condemnation of an invention inevitably leads, if the inventor is wise, to his dropping the doubtful idea and turning his intelligence to more promising objects.

RAISING THE VANGUARD.

The first paper read was one by Mr. E. J. Hough, for raising sunken vessels from deep water by covering all the openings and pumping out the water by means of pumping engines driven by compressed air from the surface. Full details of his means and appliances were given, and the inventor was of opinion that it would be possible to raise the Vanguard by the method he proposed. In the discussion which followed, the utterly hopeless character of such an undertaking was demonstrated by Admiral Selwyn, who explained the condition of the ship rapidly silting up all round, and with hundreds of ropes streaming out with the tide, forming a submarine danger for divers compared to which the octopus pictured in the imagination of Victor Hugo would be trivial. Indeed, that gallant officer and inventor incidentally mentioned a fact which disposes of all thought of the Vanguard, except as the nucleus of what may be at no distant time a serious danger to navigation in the Irish Channel. It seems that she has been sold by the Admiralty for £3,000 to a French company who have carried diving to much greater perfection than we have, and some of their best men were sent to the scene of the disaster. Some of the divers descended, and, in addition to the pressure at the depth in which the ship is lying—75 feet—making it impossible to remain down more than a minute or two, they were so appalled at the risk to life by the loose ropes swaying about in all directions that nothing could induce them to make a second attempt.

PREVENTION OF COLLISIONS AT SEA.

Before, however, adverting to that matter, it is only fair to call attention to a most valuable invention by Mr. J. J. Nickoll for preventing collisions at sea. That gentleman read the first paper of the evening on the subject of his invention, which achieved the almost unique distinction of eliciting a chorus of approbation. The principle of the invention consists of signals, both for day and night use, which are moved by and act in conjunction with the helm, showing its position, so soon as it is put either to port or starboard. For day use the signal consists of a semaphore arm in the fore part of the ship, and for night a lantern, with revolving screen, one third green glass, one third red glass, and the remainder opaque, about 18 in. high, hoisted in some conspicuous part of the foremast. In the position of helm amidships nothing is seen of the semaphore, and no light is shown by the lantern at night; but as soon as the steersman moves the helm either to port or to starboard the characteristic red for port and green for starboard is displayed in the shape of a red arm in the semaphore and a red light from the lantern when the helm is ported, and of a green arm or a green light when the helm is put to starboard. The one thing necessary to prevent collisions, especially at night in hazy weather, when two fast steamers are approaching each other at speeds from twenty to thirty miles an hour, is to ascertain at once, and with absolute certainty, which way the approaching ship is steering. At present this can only be done after the ship has answered her helm, and moved so far out of her course—when the two are meeting end on—as to obscure one of her side lights, and then the knowledge very often comes too late, and a disastrous collision is the result. By Mr. Nickoll's admirable invention the intentions of those in charge of two approaching vessels are instantly made known, and there can be no doubt that were the use of this system rendered compulsory by the Board of Trade, much wearing anxiety to seamen, a vast amount of valuable property, and many more valuable lives would be annually saved. These signals are inexpensive and easily fitted, they interfere in no way with existing lights, and they would not require any modification of the sailing and steering rules at present in force. A great improvement in side lights was exhibited by the same inventor. By the Merchant Shipping Act every vessel is bound to carry a red light on the port side and a green light on the starboard side, to show over an arc of 112°, and to be visible at two miles distance. With regard to the red light there has never been any difficulty in complying with these requirements, but the absorbent properties of green glass are so great that it is rarely possible to see a ship's starboard light even so far as a mile. It was optically a mistake to select green as one of the colors now established for signalling purposes, both ashore and afloat; but the thing is done, and all that remains is to make the best of a bad regulation. This Mr. Nickoll has done by introducing lenses which, instead of offering one inch of repellant color for the light to struggle through, have only a film of colored glass $\frac{1}{16}$th of an inch thick on the surface. Board of Trade inspectors have certified that improved lenses of this description clearly show the green light one third beyond the statutory distance, or at three miles. Here again there seems to be an opportunity for the Department to step in with advantage, and, while enforcing the Act of Parliament, give an additional guarantee for safe navigation.

INVENTIONS WANTED.

There is no doubt that the great need of the present day is some thoroughly efficient and immediately available means of saving life in the case of shipwreck or fire at sea over and above the boats at present in use. Some such appliance ought to form an integral part of every sea-going ship; while for passenger or troop ships such provision should constitute their especial features. Ordinary boats, even when fitted with the most approved lowering appliances, are at best only suitable for harbor and fine weather service. Experience only too conclusively proves that in the moment of disaster they are but a poor reliance. Some are pretty sure to be stowed away on overhead skids, and so elaborately lashed that it would take special tackling and no end of time to get them clear. Even the most unmitigated landsmen amongst the passengers, in an emergency, see that these boats can never be made available. The consequence is a panic, a rush to the boats in the davits, and the certainty that in the attempt to get these into the water three out of every four of them will be swamped, capsized, or stove against the side of the ship.

LIFE-SAVING SHIP'S BRIDGE.

One excellent suggestion was that of forming the bridges which now constitute part of the construction of all large vessels into lifeboats capable of being instantly launched overboard, without the aid of the tackles, masts, or yards, which are absolutely necessary to get a large boat overboard. There was more than one modification of this idea by different inventors; but the admirably worked-out plan of Mr. John White, of Cowes, seemed to leave nothing to be desired. A model of 40 ft. by 10 ft. was calculated to carry 125 men and many tons dead weight of provisions, water, or even cargo, and to be usefully available for landing troops, ordnance, and ammunition, carrying out an anchor, or coaling and watering the ship. All that was needed for launching was to make fast a hawser, open a port, and knock away a pair of stanchions, and then this life-boat bridge shot clear of the ship.

LIFE-SAVING RAFT.

Another excellent idea was that of Mr. John W. Hurst, an old sea captain who formed a ship's waist bulwarks into life-saving rafts, and packed similar rafts all round the poop, quarters, and stern of troopers and emigrant ships. Simply cutting a lashing was all that was needed to drop these rafts into the sea ready with oars, sails, and air-tight compartments, to stow necessaries for the reception of passengers.

HOUGH'S LIFEBOATS.

Many plans were shown for making deck seats, sheep pens, or even hen coops, available on an emergency for saving life. In its crude form Mr. Hough's lifeboat was shown in model at the same exhibition. After allowing the invention to lie dormant, he is now having a boat constructed, and it is to be hoped it will soon be submitted to crucial tests to determine whether its great promise is vindicated by performance. It is somewhat difficult to convey by mere description an idea of this novel and most ingenious invention of a gentleman who has had practical experience as a seaman, and therefore may be credited with knowing what seamen require. The boat, which is made of the best sheet charcoal

iron, consists of a pair of conical-ended buoys, the flat circular-flanged ends of which are connected by a stout spindle, on which the semi-cylindrical boat portion is freely suspended. The buoy ends, which may be filled with cork to meet the remote chance of injury to the iron, constitute the combination, a perfect lifeboat. Such a boat placed on a level ground can be readily trundled along, the projecting flanges at the base of the buoy ends forming a pair of wheels as the ends revolve, the boat all the while remaining upright by the force of gravity. Boats of this kind kept on overhead skids of a gauge to take the flanges, would run as on a railway with a trifling impulse, or even by their own gravity if the ship was slightly listed. When needed in a moment of panic, all that would be necessary would be to cut a lashing and remove a chock, when a couple of men would be able to push them overboard, even if crowded with passengers. As they would launch broadside on, there might be some little shock on reaching the water; but panic-stricken folk who would not wait to enter after launching could not fairly complain of this, more especially as they would be tolerably safe when once afloat. No possible overcrowding would overcome their buoyancy, and there would be little danger of injury or capsizing from contact with the ship's side, for the ends would revolve and keep the gunwale of the boat clear. When clear of the ship the danger of capsizing seems more remote still, for the body of the boat would have to be thrown quite out of the water and over the spindle before that could happen, and this is rendered most unlikely, if not impossible, from the buoyant ends having a tendency to rise faster than the body of the boat. If such a gyration of the body did occur, it must right immediately by the force of gravity. The side seats and the double bottom of the body are made watertight, so as to add to the general buoyancy and to give stability when too much weight is placed on one side.—*Engineering and Building Times, London.*

SPONTANEOUS COMBUSTION.

THE reports of the Royal Commission appointed to investigate this subject are decidedly against ventilation. "Of the 70 vessels that suffered in 1874, none are reported as not having been ventilated, while 30 are distinctly stated to have been ventilated, 35 of them being vessels over 500 tons. But the most startling illustration is furnished by the cases of four vessels, the Euxine, Oliver Cromwell, Calcutta, and Corah. These ships, to which reference was made by several of the witnesses who appeared before us, were loaded under the tips at Newcastle at the same time, with the same coal, and from the same seam, sometimes one ship being under the tip and sometimes another.

"They were each carrying from 1,500 to 2,000 tons of coal. The Euxine, Oliver Cromwell, and Calcutta were bound for Aden, the Corah for Bombay. The first three ships were thoroughly ventilated, the fourth was not ventilated at all. The Euxine, Oliver Cromwell, and Calcutta were all totally lost from spontaneous combustion. The Corah carried her cargo safely to Bombay." A similar illustration is afforded by the two ships Theresa and Anglia loaded with the same kind of coals. The Theresa was extensively ventilated and was totally lost by spontaneous combustion, while the Anglia was not ventilated and delivered her cargo safely. The coals were from the same pit and had been on board the two vessels about the same time.

These facts taken alone speak most powerfully against ventilation, but when taken in connection with the scientific report of Dr. Percy and Professor Abel the matter is placed beyond the shadow of doubt, and it amply qualifies the opinion of the Commission that the pressure recently put upon owners and masters to adopt systems of thorough ventilation for coal cargoes increased the risks.—*Seward's Coal Trade Journal.*

NEW TABLES OF THE VELOCITY AND FORCE OF THE WIND.

MR. ALFRED R. WOLFF, M.E., has lately pursued a series of practical experiments concerning the velocity and force of the wind, by which he has ascertained that the tables heretofore accepted and used are in some respects faulty, especially in that they fail to take into account the temperature of the wind. The importance of this factor will be understood if we bear in mind that a difference of 100° F. in temperature makes a difference of one-fifth of the total amount of wind pressure. The author has accordingly prepared the tables opposite, which it is believed will be found valuable and useful.

In the preparation of these tables the author was assisted by Mr. G. C. Henning, M.E., and Mr. A. Riesenberger, M.E. The temperature was read from a Fahrenheit thermometer; the atmospheric pressure from a Greene barometer; the velocity of wind from a Greene (Robinson) anemometer; and the pressure was observed by an arrangement devised for the purpose, which consisted of a card board one-half square foot area, suspended by a silk cord about 12 feet long from a post. Four silk cords holding the board at its corners were tied to a silk cord, which, passing over a pulley, was attached to a spring. In this way no friction except that of the pulley was introduced, and this, as well as the weight of the string + the force of the wind upon the string acting upon the spring, was deducted from the pressure read off on the scale every 15 seconds.

The author states that it has been noticed in the United States that a windmill will run but 8 hours per day in the interior States and 10 hours per day on the coast. Eight hours may be taken as the average number per day that a mill will run in New York, then deducting as much as one-third of the mileage per day as lost, the wind being too slow to cause rotation of the mill, two thirds of the mileage per day will be distributed on 8 hours; and the actual average velocity of the wind producing rotation of the mill will equal 22·72 ft. per second. In applying the motive power of wind to windmills, it must be remembered not only that the mill be made light enough to work under the action of light winds, but also strong enough to withstand heavy gales.

The variations in the velocity and pressure of the wind are considerable, even so within a brief time, and sometimes sudden and extreme. Winds of immense velocity and pressure are on record. A very violent gale in Scotland registered by an excellent anemometer a pressure of 45 lbs. per square foot. During the severe storm at London, on February 6th, 1867, the anemometer at Lloyd's registered a pressure of 35 lbs. to the square foot. The gauge at Girard College, Philadelphia, broke under a strain of 42 lbs. per square foot, a tornado passing at the moment within a quarter of a mile. At the Central Park Observatory, in the middle of March, 1876, a wind was recorded of 28·5 lbs. per square foot pressure.

The windmill is a very ancient contrivance. In the 77th proposition of Hero's "Spiratalia," a work written 120 years before the Christian era, a windmill is represented as applied to blow an organ, the air being forced into the air chest of the organ by means of a cylinder and piston worked by the windmill. In the East the windmill was used in ancient times for raising water for the purposes of irrigation. Records exist showing their use in France in 1105, England 1200, Spain 1300, the authenticity of which has never been questioned.

VELOCITY OF WIND.		PRESSURE IN POUNDS PER SQUARE FOOT OF SURFACE, WHEN P=29·116 AND TEMPERATURE OF WIND=						
Miles per hour.	Feet per second.	0° F.	5° F.	10° F.	15° F.	20° F.	25° F.	30° F.
1	1·46⅔	·005371	·005312	·005256	·005201	·005147	·005094	·005042
2	2·93⅓	·021482	·021252	·021025	·020802	·020586	·020373	·020165
3	4·39⅓	·048335	·047814	·047305	·046807	·046318	·045841	·045372
4	5·86⅔	·085930	·085006	·084100	·083214	·082345	·081495	·080663
5	7·33⅓	·134271	·132824	131409	·130024	·128668	·127339	·126038
6	8·80	·193354	·191271	·189239	·187240	·185287	·183374	·181500
7	10·26⅔	·263186	·260353	·257588	·254863	·252205	·249601	·247051
8	11·73⅓	·343767	·340066	·336442	·332895	·329423	·326023	·322690
9	13·20	·436283	·430524	·425829	·421340	·416945	·412640	·407823
10	14·66⅔	·537188	·531404	·525741	·520200	·514772	·509457	·505124
11	16·13⅓	·650036	·643035	·636183	·629476	·622908	·615477	·610207
12	17·60	·773645	·765308	·757157	·749171	·741357	·733608	·726204
13	19·06⅔	·908020	·898240	·888667	·879296	·870122	·861136	·852335
14	20·53⅓	1·053166	1·041821	1·030718	1·019849	1·010206	·99·769	·988575
15	22·00	1·209087	1·196062	1·183314	1·170835	1·158616	1·146650	1·134928
16	23·46⅔	1·375798	1·360966	1·346460	1·332258	1·318354	1·304737	1·291397
17	24·93⅓	1·553273	1·536540	1·520160	1·504126	1·488425	1·473052	1·457991
18	26·40	1·741556	1·722792	1·704423	1·686444	1·668839	1·651599	1·634711
19	27·86⅔	1·940634	1·919720	1·899252	1·879215	1 859596	1·840384	1 821564
20	29·33⅓	2·150516	2·127337	2·104653	2·082447	2·060705	2.039361	2·018555
25	36·66⅔	3·362250	3·325986	3 290499	3·255761	3·221749	3·188486	3·155813
30	44·00	4 845284	4·792984	4·742008	4·691710	4·642662	4 594628	4·547752
35	51·33⅓	6·600829	6·529525	6·459835	6 391739	6·324565	6 259067	6·194814
40	58·66⅔	8·630351	8·537048	8·445701	8·356310	8·268791	8·183131	8·099137
45	66·00	10·935522	10·817138	10·701289	10·587884	10·476877	10.368165	10·261687
50	73·33⅓	13·518265	13·371732	13·228340	13·087991	12·950585	12·816051	12·684268
60	88·00	19·525304	19·313019	19·105299	18·902010	18·702993	18 508122	18·317252
80	117·33⅓	34·98153	34·59832	34·22333	33·85544	33·49730	33 14573	32·80146

VELOCITY OF WIND.		PRESSURE IN POUNDS PER SQUARE FOOT OF SURFACE, WHEN P=29·116 AND TEMPERATURE OF WIND=						
Miles per hour.	Feet per second.	35° F.	40° F.	45° F.	50° F.	55° F.	60° F.	65° F.
1	1·46⅔	·004990	·004940	·004889	·004842	·004796	·004750	·004705
2	2·93⅓	·019662	·019761	·019565	·019374	·019185	·019001	018818
3	4·39⅓	·044914	·044465	·044026	·043591	·043166	·042751	·042344
4	5·86⅔	·079847	·079048	·078264	·077496	·076743	·076008	·075277
5	7·33⅓	·124764	·123514	·122290	·121090	·119912	·118758	·117625
6	8 80	·179665	·177867	·176103	·174374	·172679	·171017	·169386
7	10·26⅔	·244552	·242112	·239703	·237350	·235043	·232780	·230560
8	11·73⅓	·319427	·316228	·313093	·310019	·307005	·304050	·301159
9	13·20	·404292	·400243	·396285	·392385	·388570	·384828	·381159
10	14·66⅔	·499150	·494151	·489252	·484429	·479739	·475121	·470587
11	16·13⅓	·604003	·597955	·592026	·586212	·580513	·574923	·569440
12	17·60	·718857	·711656	·704600	·697681	·690824	·684244	·677718
13	19·06⅔	·843711	·835260	·826977	·818857	·810894	·803085	·795424
14	20·53⅓	·978572	·968770	·959162	·949743	·940507	·931449	·922564
15	22·00	1·123444	1·112190	1·101159	1·090344	1·079746	1·069347	1 059139
16	23·46⅔	1·278330	1·265523	1·252964	1·240664	1·228542	1·216763	1·205154
17	24·93⅓	1·443235	1·428786	1·414602	1·400706	1·387083	1·373721	1·360613
18	26·40	1 618167	1·501951	1·586058	1·569519	1·554854	1·540180	1·525506
19	27·86⅔	1·803125	1·785056	1·767345	1·749982	1·732957	1·716260	1·699882
20	29·33⅓	1·997617	1·978095	1·958464	1·939225	1·920357	1·901853	1·883702
25	36·66⅔	3·123847	3·092521	3·061819	3·032543	3·002206	2·973201	2·944892
30	44·00	4·501482	4·456311	4·412038	4·368636	4·326079	4·284344	4 243405
35	51·33⅓	6·132081	6·070498	6·010033	5·950698	5·892963	5·836055	5·780246
40	58·66⅔	8·016896	7 936307	7·857321	7·777933	7·703980	7·627948	7 556501
45	66·00	10·157373	10·055155	9·954978	9·856776	9 760493	9·666070	9·573460
50	73·33⅓	12·555160	12.428668	12·304691	12·183167	12·064021	11·947178	11·832584
60	88·00	18·130194	17.947145	17·767641	17·591679	17·419165	17·250017	17·084114
80	117·33⅓	32·46424	32·13392	31·81022	31·49300	31 18203	30·87715	30·57819

VELOCITY OF WIND.		PRESSURE IN POUNDS PER SQUARE FOOT OF SURFACE, WHEN P=29·116 AND TEMPERATURE OF WIND=						
Miles per hour.	Feet per second.	70° F.	75° F.	80° F.	85° F.	90° F.	95° F.	100° F.
1	1 46⅔	·004660	·004617	·004574	·004532	·004491	·004450	·004410
2	2·93⅓	·018642	·018586	·018294	·018128	·017964	·017801	·017641
3	4·39⅓	·041944	·041551	·041166	·040788	·040717	·040052	·039694
4	5·86⅔	·074568	·073870	·073185	·072514	·071854	·071205	·070568
5	7·33⅓	·116515	·115424	·114355	·113305	·112274	·111261	·110267
6	8·80	·167786	·166216	·164675	·163153	·161678	·160219	·158784
7	10·26⅔	·228382	·226244	·224148	·222091	·220091	·218082	·216140
8	11·73⅓	·298306	·295514	·292774	·290086	·287444	·284852	·282265
9	13·20	·377558	·374025	·370555	·367153	·363811	·360529	·357305
10	14·66⅔	·466142	·461779	·457498	·453295	·449169	·445118	·441195
11	16·13⅓	·564058	·558780	·553600	·548513	·543527	·538644	·533815
12	17·60	·671315	·665032	·658865	·652815	·646868	·641032	·635301
13	19·06⅔	·787909	·780463	·773290	·766191	·759216	·752413	·745638
14	20·53⅓	·913850	·905292	·896879	·888655	·880567	·872587	·864814
15	22·00	1·049130	1·039309	1·029670	1·020208	1·010919	1·001797	·992841
16	23·46⅔	1·193758	1·182589	1·171621	1·160853	1·150283	1 139908	1·129707
17	24·93⅓	1·347754	1·335135	1 322751	1·310648	1·298659	1·286939	1·275429
18	26 40	1·511162	1·496795	1·482666	1·468735	1·456052	1·442609	1·429470
19	27·86⅔	1·683813	1·668046	1·652571	1·637380	1·622467	1·607822	1 593439
20	29·33⅓	1·865894	1·848420	1·831270	1·814436	1·797908	1·781722	1·765740
25	36·66⅔	2·917015	2·889683	2·862857	2·836526	2·810674	2·785290	2·760359
30	44·00	4·203242	4·163832	4·125157	4·087178	4·049715	4·013315	3·979371
35	51·33⅓	5·725495	5·671771	5·619046	5·568291	5·516483	5·466594	5·417590
40	58·66⅔	7·484862	7·414568	7·345581	7·277867	7·211390	7·146115	7·082012
45	66·00	9·482606	9·393460	9·305975	9·220106	9·135806	9·053001	9·971746
50	73·33⅓	11·820187	11·609840	11·501614	11·396559	11·291664	11·188654	11·088085
60	88·00	16·921371	16·761700	16·605025	16·451238	16·300276	16·151954	16·006591
80	117·33⅓	30·28493	29·99726	29·71502	29·43801	29·16611	28·89922	28·863716

SOCIETY OF TELEGRAPH ENGINEERS.

AN ordinary general meeting of this society was held in January at the Institution of Civil Engineers, Great George Street, Westminster, London. The first business done was to pass a hearty vote of thanks to Mr. C. W. Walker, F.R.S., the retiring President of the Society, under whose auspices, it was said, it had gone on increasing in numbers and importance.

Professor Abel, F.R.S., the President for the ensuing year, then proceeded to deliver his inaugural address, which he commenced by observing that the prominent position to which the Society had attained among the associations in applied science must in a great measure be ascribed to the wisdom which had hitherto been exercised by its members in the selection of the men to whom had been intrusted the management of its affairs. He, however, who had contributed nothing to the pure science of electricity or to the advancement of telegraphy could hardly have hoped in the wildest flight of his imagination to succeed to a position which had been occupied by such men as Siemens, Scudamore, Thompson, Clark, and Walker, and he could only attribute his selection for the post of President of the Society to a desire on the part of its members to testify their recognition of the special importance of chemical science in its application to the work of the telegraph engineer. So strong was his con viction that it was to that consideration he owed the privilege of addressing them that evening that he felt confident he was only rightly interpreting their wishes in endeavoring to illustrate some of the principal directions in which chemical science bore importantly upon that work. And there could, he thought, be no better illustration of the value of combining chemical with electrical research than that which was furnished by the investigations of the late Dr. Matthiessen, relating to the causes of the differences in electrical conductivity exhibited by different kinds of commercial copper. By a systematic series of experiments, that accomplished chemist ascertained, in the first instance, the influence exerted upon the conducting power of pure copper by the principal metalloids and metals known to be naturally associated with it, and afterwards determined the conducting powers of important varieties of commercial copper. The conducting power of pure copper he found not to be susceptible of increase by alloying the metal with any other substance, while certain non-metallic elements occurring as very frequent impurities in the copper of commerce exercised a very prejudicial influence on its conducting power. Thus, the conductivity of pure galvanoplastic copper being fixed at 100, the addition of only traces of arsenic to the metal reduced its conductivity to 60. Some further experiments of Matthiessen elucidated the cause of the good effects produced upon the working qualities of refined copper by the addition of small quantities of lead, which operated in removing some impurities which were detrimental to its toughness and ductility. A sample of pure copper after fusion in contact with air had a conductivity of only 87·25; 0·1 per cent. of lead was added to the metal, the two being fused together in a current of carbonic acid, and by that treatment conductivity was raised to 98. The analysis, Professor Abel went on to say, which Dr. Matthiessen made of a series of commercial coppers, the conductivity of which ranged from 14 to 92, and of six specimens of the core of the Gibraltar cable, the conductivity of which ranged from 67·4 to 90·7, afforded interesting confirmation of the results of his investigations upon the conductivity of pure copper, and contributed in a very important degree to indicate to the wire manufacturer the sources whence he should obtain, or the conditions as regarded purity to be fulfilled, in preparing metal of a quality best suited to the purposes of a telegraph engineer. But while chemical science had unquestionably facilitated the selection of fitting materials for the conductors of cables, it had also been usefully applied in connection with the substances available as dielectrics in cable manufacture, and it was in that direction especially that important benefits from the labors of the chemist were to be looked for in the future. The Submarine Telegraph Committee, the result of whose inquiry was published in a valuable Blue-book in 1861, requested Professor W. A. Miller to investigate the causes of the decay of gutta-percha and india rubber, and he arrived at the same conclusion as that to which Professor Hoffman had previously come—that decay was due to oxidation, through atmospheric influence, of the gum, which became transformed to a more or less considerable extent into a brittle resinous substance. Professor Miller also pointed out that an intermittent exposure of moisture, particularly if solar light had access, was rapidly destructive of gutta-percha, while if kept continually immersed in water it remained practically unchanged for indefinite periods. Now, the mechanical processes of preparation of gutta-percha had doubtless undergone considerable improvements since the date of the Marine Telegraph Committee's Report, but, judging by the results of some chemical examinations which he himself had recently made of samples of new gutta-percha, it did not appear to him that there was much improvement in the quality of the material as indicated by its chemical composition, for although a high-priced sample contained just below 13 per cent. of resin, it contained even more inclosed water than two somewhat lower priced samples, while in several samples offered at about the same price, by different well-known makers, the resin ranged from 20 to 27·5 per cent., and the water from 3 to 12 per cent. Professor Abel, after dwelling at length upon this part of his subject, went on to give some illustrations from his own experience of the imperfect nature of existing knowledge regarding the chemical and other conditions to be fulfilled in the application of vulcanizing processes to the preparation of telegraph cables. It was scarcely necessary, he added, to impress upon the Society the importance of the application of chemical research to the more complete study of the causes of the defects in the dielectrics at present in use, and to the production of insulating preparations suitable for cable covering which should possess the chemical as well as physical qualities essential to permanence. The efforts which had been made from time to time to produce new insulators or to improve the existing ones might be said to have served until lately chiefly to clear the ground for future experiments; but there was one direction in which, after repeated efforts, an important success appeared to have been achieved. One of the most absolutely permanent materials of organic origin was the solid product of the distillation of peat and of certain descriptions of coal or bituminous minerals which also existed in many varieties of petroleum or mineral oils, and which was known as paraffin or as fossil-wax. That substance, which during the past 30 years had passed from the obscure position of a chemical curiosity to the foremost rank among important chemical products, thanks to the practical development of the results of pure chemical research, was possessed of high insulating power, and had consequently received some useful applica-

tions in connection with telegraphy, although it was deficient in certain characteristics indispensable in a dielectric for covering wire. Professor Abel next referred to batteries as a subject of primary importance to the telegraph engineer, and one which could not be grappled with in the absence of sound chemical knowledge. In conclusion, he expressed his regret that the length of his address prevented him from dealing with the question of torpedoes, for there could, he thought, be no doubt that the elaborators of torpedo service in England had already, by some of the results of their studies and of their varied, though limited, experience, repaid in a great measure the invaluable aid derived by them from the telegraph engineer.

A vote of thanks, proposed by Mr. W. H. Preece, and seconded by Major Champain, was unanimously passed to the President for his address.

MOTIONS PRODUCED IN MERCURY BY ELECTRICITY.

IN the spring of 1875, the attention of the late Sir Charles Wheatstone was directed to the discovery of Erman (1809), that a globule of mercury in contact with an electrolytic liquid within a tube of small calibre moved forward when a current of electricity was passed through it. Sir C. Wheatstone patented a form of telegraph-receiving instrument depending on this principle. Mr. Robert Sabine has been making some interesting experiments in connection with this instrument (*Phil. Mag. Suppl.*, December, 1876), and has been led to assign to the experiment cited above, and to others of a similar nature, an explanation different from that which has been usually accepted. This explanation is based on the observed fact that a mercurial surface, when exposed to the influence of air or of water, consists of mercurous oxide, and not of metallic mercury, that the electro-positive condition of a mercury surface is greatly dependent upon its state of oxidation, that the expansion or contraction of such a surface is always attended with a corresponding alteration of its electro-positiveness; and, finally, that the motion of mercury elec rodes under water (pure or acidulated) are principally due to the reduction of superficial oxide. An ordinary U tube had mercury poured into the bend, to about an inch up each limb; acid water covered the mercury surfaces, and platinum wires, connected with a galvanometer, were inserted in the water. When the tube was tilted, the needle of the galvanometer showed a deflection, whose direction was reversed when the tube was tilted the opposite way. The electricity thus produced was due to the advancing surface of the mercury becoming brighter—unoxidized portions breaking through to the front—and, consequently, more electro-positive than the receding surface, which became duller. In his paper on the connection between capillary and electrical phenomena (*Phil. Mag.* [iv.] xlvii. p. 281), M. Lippmann ascribed the electricity, which he observed to be disengaged when a mercury surface in acid water advances in a capillary tube, to a change in its capillary constant. Mr. Sabine considers that the electricity in question may be accounted for by different states of oxidation of the advancing and receding surfaces. When a current of electricity is passed through a horizontal tube containing water or dilute sulphuric acid, with a globule of mercury in the center, the globule is seen to move in the direction of the current. This arrangement constitutes, in fact, practically Lippmann's capillary electrometer, and its action is explained by its author as being due to a change of the surface tension of the mercury at its two ends, where oxygen and hydrogen are respectively evolved. According to Mr. Sabine, capillarity has very little to do with the phenomenon, which is to be ascribed to the chemical changes taking place in the mercury globule. At the deoxidized end its atomic volume diminishes, but increases at the oxidized end, where, in consequence, a relative expansion takes place. Circulation of the mercury particles ensues, and if the tube be horizontal the globule marches with the current. A number of experiments are adduced in favor of this view. Mr. Sabine, however, probably depreciates too much the effect of capillarity.

THE LAWS OF THE PASSAGE OF ELECTRICITY THROUGH GASES.

A PAPER by M. G. Wiedemann on this subject is published in *Pogg. Annal.* An abstract of it will be found in the December number of the *Journal de Physique*. The apparatus employed by M. Wiedemann was a Holtz machine, one of the conductors of which was in connection with the earth. The other communicated with one of the electrodes between which the discharge took place, the other electrode being connected with the earth by a circuit of which a galvanometer formed a part. Without going into the facts observed by M. Wiedemann, we may state some of the conclusions which he drew from them: The discharge, or rather the series of discharges, taking place between the two electrodes cannot be assimilated to an electric current; the more or less rarefied air or vapors offer no resistance in the electrodynamic sense of this word. A certain charge is necessary on each electrode before discharge can take place. This limit attained, the gaseous molecules are driven far from the electrodes, carrying with them the electricity with which they are charged. The differences noticed by observers in the luminous appearances at the two electrodes, as also the differences in the intensity and number of discharges between two electrodes of different forms, when the direction of the current is reversed, are attributed by M. Wiedemann to the fundamental fact that the positive discharge only commences when the potential of the positive electrode has attained a value superior to that for which the negative discharge takes place.—*Academy.*

THE GALVANIC EXPANSION OF METALLIC WIRES.

EDLUND found that when a current of electricity is passed through a metallic wire an elongation of the wire takes place, independently of that produced by the heating effect of the current. In the wires with which he experimented, the galvanic expansion varied from 6·5 to 2·8 per cent. of that due to the heating of the wire by the current. Streintz carried out a series of experiments on the same subject, which led him not only to confirm Edlund's conclusion, that there is a galvanic lengthening of a wire through which a current passes, distinct from the thermal lengthening, but to assert that it is very much greater than Edlund had found it, being in the case of iron as much as 27 per cent. of the thermal expansion. M. Exner, in a paper in *Poggendorf's Annalen*, describes his own experiments in this subject, which appear to have been conducted with great care and thoroughness, and gave very consistent results. The metals operated on were copper, platinum, iron, steel, and brass, the wires being in all cases both annealed and hard drawn, and the galvanic expansion was found never to exceed 2·2 per cent. of that caused by the elevation of temperature. Streintz's numbers are thus shown to be far too high. To prevent the heating of his wires, M. Exner inclosed them in glass tubes, through which was maintained a running stream of pure cold water. One would have expected that the intensity of the current would be thereby affected, since a portion of it would traverse the liquid instead of the wire, but it was found that, so long as the water was pure, the galvanometer reading was the same whether the tube was full of water or empty.

A NEW ELECTRIC REPULSION AND ITS APPLICATION TO THE THEORY OF COMETS.

WHEN the finger or a conductor of any kind is brought near to the luminous column produced in a Geissler's tube, we observe an attraction, which is explained by the known laws of electric induction. MM. Reitlinger and D'Urbanitsky (*Comptes Rendus*), observe that this attraction is converted into a repulsion when the rarefaction of the gas in the tube is pushed beyond a certain limit. In operating upon a number of gases, they found between pressures of 8 mm. and 2 mm. the known attraction. In continuing the exhaustion, a neutral point was reached, at which there was neither attraction nor repulsion; after which the same gases exhibited a repulsion as pronounced as was the attraction. It may be observed at a distance of six centimètres, but does not manifest itself when an insulator instead of a conductor is approached. The authors apply this observation to explain the repulsion of comets' tails by the sun.

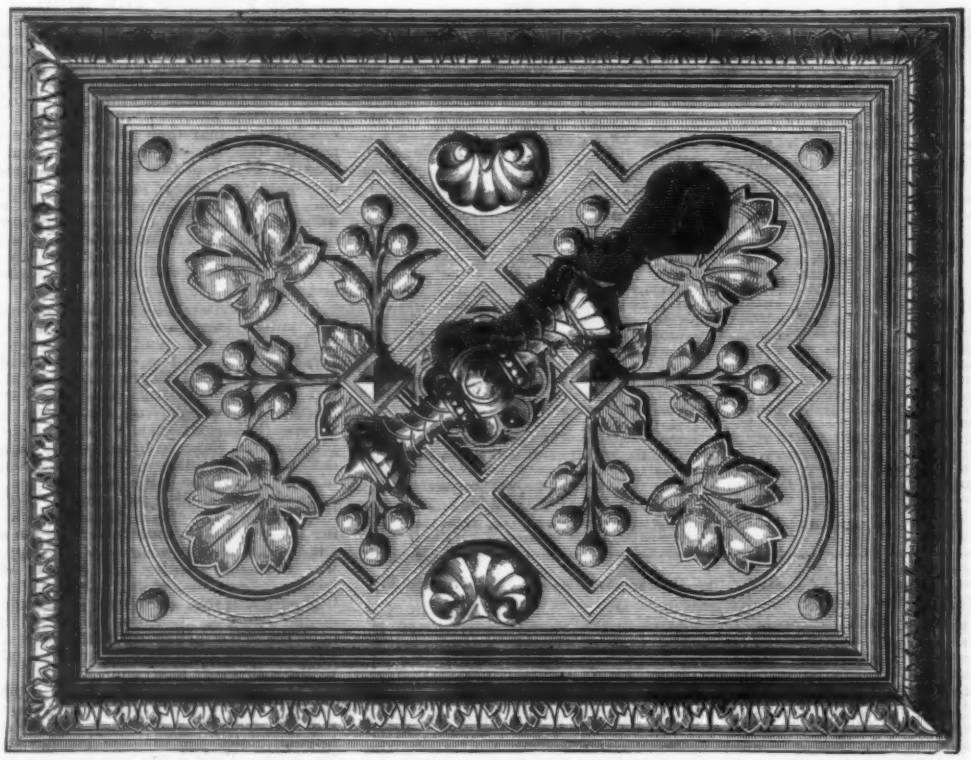
CONCRETE CONSTRUCTION.

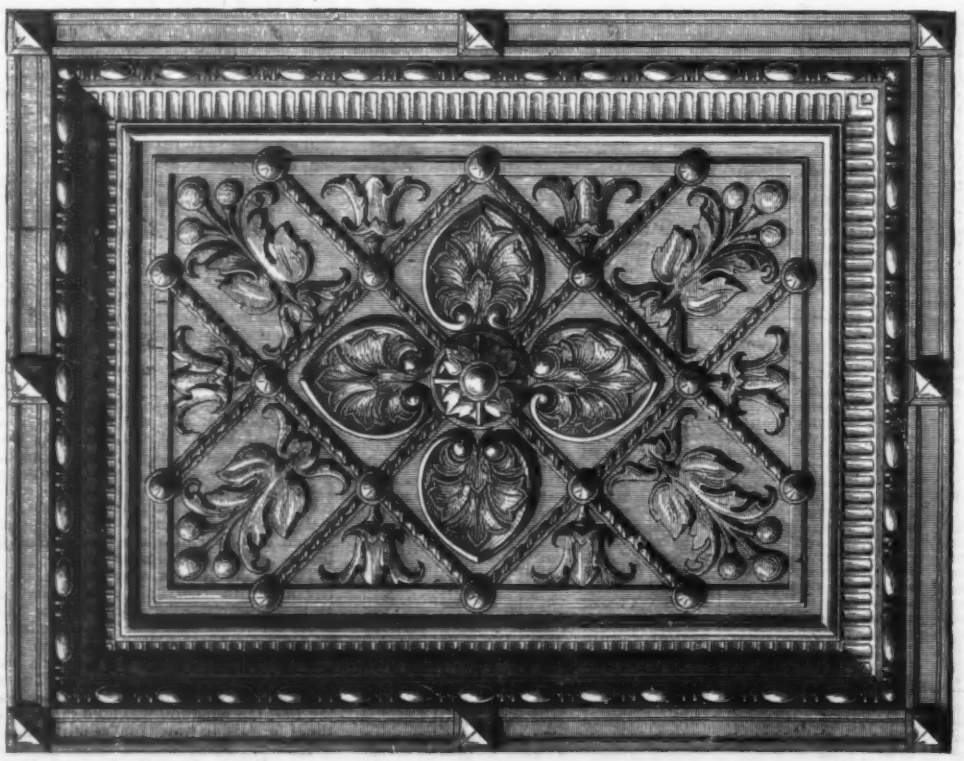
AT the suggestion of Lord Elcho, M. P., a committee has been appointed by the Institute of British Architects, with the view of reporting on the subject of "Concrete as a Fire-resisting Material," to the Select Committee of the House of Commons. In order to collect information for the guidance of the committee, the inclosed form has been drawn up for issue to the members generally:

LIST OF QUESTIONS TO BE ANSWERED.

1. State the composition of the concrete, with the relative proportions of the materials.
2. Explain the manner of mixing, and mode of use.
3. State the strength in compression, extension, and cross strain.
4. Give the thickness and other particulars of the walls, specially describing any use of iron or other materials in their construction.
5. Give the same information in regard to floors.
6. Give the same information in regard to roofs.
7. Give the same information in regard to staircases.
8. Give the same information in regard to thin partitions.
9. Give the same information in regard to columns, piers, etc.
10. Give the same information in regard to lintels.
11. Give the same information in regard to doors, shutters, etc.
12. State the effect of fire on the structural features referred to in your answers to questions 4 to 11 inclusive, giving such particulars as may be known with respect to the intensity of the fire, and such other details as will enable the committee to form a correct estimate of the material as a fire-resisting substance, describing particularly whether the building is one of the ordinary class of dwelling houses, or whether of the warehouse class, and liable to be filled with inflammable goods.
13. Give your experience or concrete as a building material, irrespective of its value in resisting fire.

Much valuable information concerning concrete may be expected from this committee, reports of which we shall duly present.





CARVED PATTERNS FOR DOOR PANELS OF IRON STOVES. BY IHNE & STEGMÜLLER, BERLIN.
(From the Workshop.)

WESTERN NEW YORK SOCIETY.

MR. BATEHAM, of Ohio, said they could not get good apples in that state without cultivation. They found it the only way to escape from the codling moth. He found that hogs and sheep, in addition, prevent any serious damage from this insect. Paper bands were too troublesome and inefficient in large orchards. Injury to the bark of the trees by sheep was prevented by keeping them in the orchard only two or three days at a time. But the best way to prevent harm from sheep was to apply to the bark a wash of carbolic acid and soap diluted with water. J. Crane, of Lockport, preferred the quality of fruit grown on old trees. On young rapid growers, they were coarse and not so good. He was not in favor of seeding orchards to grass, unless the trees grew too fast to bear, and even then temporarily. He thought the cheapest way to manure orchards was to plow in peas annually. J. C. Allis, of Orleans County, said that when his orchard was in grass, it would not yield one-half as much good fruit as when under the plow. He found the cheapest way, with the best result, was plowing in buckwheat. This increased the fertility every year. Rye was more troublesome, being a weed. Poultry had proved better than hogs, and they lived on the scattered buckwheat. Mr. Newton, of Parma, favored a rotation of crops, namely, two years in clover or grass, and three years in cultivation. A. Quimby, of Monroe County, had practised cultivating and manuring for forty years, and had found it invariably the best. Mr. Woodward, of Lockport, cited the successful example of Peter Miller, whose orchard was heavily manured, the soil naturally a fine medium loam on chestnut ground; it has always been in cultivation, never seeded, and one year he sold the crop for $9,000. It contained 15 acres, and usually had hoed crops for 15 years, but the last six years had no crop, the surface being kept clean. He had used ashes in addition to the manure, but has not seen any visible result. His trees are all perfect, and thrifty strong growers. A. C. Younglove, of Vine Valley, entered his protest against grass or any sowed crop, such as clover or buckwheat, among young trees; and as they became larger preferred to top dress.

[In all the preceding cases, interesting and striking as some of them are, there is a great deficiency in definite trials and results. The only way to judge fairly and distinctly is to try the several modes of management in different parts of the same orchard, and examine the fruit, and carefully measure it from each portion. In most of the cited instances the whole orchard was treated alike throughout.]

FRUIT HOUSES.

M. B. Bateham read a paper on storing and keeping apples with a view to commanding a good spring market. If fresh fruit could be kept beyond the present limit, it would afford important assistance in marketing in seasons of heavy crops. When there is an overplus in autumn, it cannot be sold at a profit. Hence thousands of barrels were left ungathered the past season; and hence the reason that so many orchards have been unprofitable to the owners. If good fruit could be kept sound till May and June, a good foreign market would probably open for it. Common cellars are too changeable in temperature, and too badly ventilated. The ice-cooled apartments of modern inventors injure the flavor. The best fruit houses of this character are too costly. Mr. B. described a fruit house, invented by Nathan and Joseph Cope of Ohio, that has obviated nearly all these serious objections. The latter has made an important improvement, making his house much the best of the two. It was patented to prevent opposition in the business. A car load of fruit was sent from this house in June to Chicago, and commission men said it was better in flavor than that from the more expensive fruit houses. This house is 50 feet long and 25 feet wide, and will hold about 5,000 bushels of apples. The walls are of double boards filled in with tan. It is one and a half stories high. The roof is also protected with tan. Padded shutters exclude heat and frost after it is filled. The first apartment is below, and is entered from above, to prevent the ingress and egress of air from without. A railway truck runs through to carry fruit. Ventilation is effected by pipes and ducts, not like that of the best modern buildings. By the ventilating process (assisted when needed by a small wood fire in the flue above), cold air is thrown in on any cold night in autumn or spring, and at once fills the house. The non-conducting walls are made so secure that when once filled with cold air, it will remain cool a month. Hence there is no difficulty in keeping a constant low temperature, accurately controlled by the assistance of thermometers. The fruit is gathered in crates and kept in them or in bins.

The cost of this house is slightly more than that of a common barn—in the cheaper form about $500; more finished about $700. There is scarcely any assorting of apples needed to separate sound and decayed ones in spring; no spreading of rot, no mildew. Its great advantage over common fruit houses is that the heat, on the approach of warm weather, is not allowed to enter, and the air and the large masses of cold fruit are kept cold a long time. In very cold weather, when the thermometer has gone to 40° below zero, the fruit has not frozen. The privilege of using the invention is granted for from fifty to a hundred dollars for a house or township.

Mr. Porter, of Fredonia, said that he had built, five years ago, a cellar two stories or 15 feet deep, on a principle somewhat similar. There is a chimney in the center for ventilation. Openings are made into it just below the floors overhead. A small fire in the chimney above produces a current which draws the cold air from out-doors through openings and pipes which convey it down near the floor of each story from outside. These are used only when the apartments are to be filled with cold air. The apples are packed in crates. They had been sold in May perfectly sound and fresh.

ENTOMOLOGY.

Prof. Comstock, of Cornell University, read a paper on the importance of the study of entomology, showing that a whole lifetime is required to understand the subject fully, and even that length of time is not sufficient. It requires many appliances, apparatus, and costly libraries with books for reference. Hence, while all cultivators of the soil should know something of the science for practical purposes, there should be a center of intelligence to which they can apply in case of any doubtful question. The faculty of Cornell University have opened a department in Entomology, the advantages and facilities of which Prof. C. explained in detail. He invited horticulturists to unite in promoting its objects, as their time is so much in the field, by furnishing specimens, especially those illustrating the habits of insects, and in return they will be furnished with information. He requested calendars of insects, showing the times of their appearance in different localities, as compared with the times of the flowering of common garden or other plants. The dissemination of information on all subjects connected with the study in various ways through the community will be a prominent object.

H. T. Brooks said an orchardist informed him that the codling moth had so increased that he had only 50 barrels of sound apples out of 500 barrels, and at least three-fourths of his crop was effectually spoiled. He strongly urged turning sheep and hogs into orchards, and recommended the use of the paper bandages besides. One of the best means of preventing the ravages of insects generally is thorough cultivation and vigorous growth.

Eugene Glen read a paper, urging, instead of granting patents for new fruits, the use of exclusive names as trade marks.

MARKET FOR SURPLUS APPLES.

Mr. Woodward, of Lockport, said he was not in favor of flooding the market with second-rate apples. He preferred to work them up by drying and other processes. A neighbor had used these apples for drying and had found it profitable, employing the best artificial dryers. He also spoke of the large quantities sent this year to Europe, amounting to 240,000 barrels, as showing the new market opening for the very best selections. It was very important to permit none but the very best specimens to go there, so as to establish a favorable impression. An Englishman familiar with the trade had lately said: "We shall have to look well to our laurels, or we shall be superseded by American fruit." It has been sent as far as to St. Petersburgh at a cost of only fifty cents per barrel. The system of drying which Mr. Woodward mentioned is known as the Williams process, and was invented in Michigan. H. D. Adams of that State said that the Alden process, the Williams process, and the Bissell process are all essentially the same in principle, and only differ in the details.

Several members mentioned the profitable manufacture of perfectly sweet and fresh apple juice into excellent jelly by means of Cook's sorghum evaporator. This process, it was thought, promised to open a wide business in disposing of surplus crops.

[COUNTRY GENTLEMAN.]

HORTICULTURAL NOTES.

PLANTING STRAWBERRIES.

WILLIAM PARRY, who has been so successful in the culture of small fruits, adopts the following course as a good one in setting out strawberry plants: He plows furrows two and a half feet apart, and spreads along them a mixture of equal parts of muck, marl, ashes and ground bone. They are to be mixed a fortnight before using Three-fourths of a ton of this mixture per acre gives a luxuriant growth to the plants. This result might not be so successful on all soils. These rows are cultivated with a horse. He finds a good coat of stable manure, just before winter, of great importance.

LARGE STRAWBERRIES.

A correspondent of the *London Garden* describes the manner in which he obtains fruit from strawberry beds, many of the berries measuring eight inches in circumference, and sixteen placed in a row have measured three feet—an average of two and a quarter inches in diameter. His practice is to plant often, and manure well, on an excellent soil. We sometimes have as large strawberries in this country, but the moist climate of England more particularly favors a large growth.

HOT-BEDS.

The *Fruit Recorder* thinks the best manure for hot beds is a mixture of forest leaves and stable manure; and that the best way to obtain this mixture is to use leaves to litter the stables in winter.

PEARS IN MISSOURI.

A writer in Colman's *Rural World* says, that more than fifty thousand pear trees are annually set out in Missouri, not one in ten of which survives the ninth year in the orchard. They grow vigorously at first, and afterwards gradually perish under a modification of the blight. Yet here and there a tree is found that has remained sound for more than half a century, yielding annually wagon loads of fruit. It would be worth a good deal of investigation to find out the reason of the difference, so as to profit by it in planting.

RABBITS.

A writer in Colman's *Rural World* gives a simple protection for young fruit trees against rabbits. It is to place a few cornstalks about the stem, with the lower ends tied near the ground, and the other end tied as high as the protection is needed. This application is found as good as paper, and more likely to be ready at hand for farmers.

TWENTY-OUNCE APPLES.

At the discussions of the Western New York Farmers' Club, it was remarked by several members that the codling moth had been much more destructive the past season than usual to the apple crop. Wm. Otis, of Rochester, said he had not seen a perfect apple this year. But the fairest fruit and the best annual bearer was the twenty ounce apple. The fact, therefore, that it has proved tender in some parts of the country should not induce planters to reject it without further trial.

WINTER BLOOMING OF GLADIOLUS.

A Boston correspondent of the *Gardener's Monthly* recommends, in substance, the following mode for obtaining winter flowers from the gladiolus: Plant the bulbs about the middle of July in a rich, open border. When a foot high, and in dry weather, pot them. Before frost, remove to a sunny window in the house, and keep them well watered. If the bulbs are planted in pots now, and brought on slowly at first, they will flower in spring.

TREE SCULPTURE.

A late writer, speaking of the practice of distorting the free and graceful natural forms of trees by clipping or shearing into imitations of animals and structures, says, with a good deal of justice: "If a number of lunatics were gifted with power to organize their efforts to some frivolous end, they could hardly occupy themselves with anything more absurd than clipping trees."

APPLES FOR MISSOURI.

Colman's *Rural World* gives the following list, after examining and testing a large number as the very best for carrying a supply through autumn, winter and spring: Rome Beauty, Smith's Cider, Jonathan, Rambo, Winesap, Ben Davis, and Rawle's Janet. In addition to these, Baldwin, Esopus, Spitzenburgh, and American Golden Russet are fine, but do not yield so full a crop.

APPLE ORCHARDS OF OHIO.

A report was made to the Montgomery County Horticultural Society of 381,000 acres of orchard in that State, which yielded 15,918,000 bushels of apples in 1874, or 42 bushels to the acre as an average.

ABOUT STRAWBERRIES.

I AGREE with Amos Miller that the Monarch of the West is a very fine variety, and with me it ripens at the end as well as any of the mammoth kinds. Last year, with common field culture, on the same ground with young pear trees and bearing currant bushes, growing in matted rows, I had the finest show of berries I ever saw. The largest berry I measured was plump 8¼ inches around. The yield of these Monarchs I considered from one-half to two-thirds that of the Wilson in measure; in value fully equal. In my opinion there is just one thing lacking to make the Monarch the common berry—*coming to stay*, unlike most of the new ones—and that is the prolificacy of the Seth Boyden, which is entirely unequalled by any of the fifty old and new berries I fruited last year. A small plot in the corner of my strawberry field (all I had of this kind) produced at the rate of over $1,700 per acre, which I have never equalled with any other crop.

I think the Cumberland Triumph very promising. It seems to excel the Monarch in flavor and yield; and, in beauty and perfect form, the Jucunda and Wilder, which it also surpasses in vigor of vine. The Prouty and Sterling both promise well, and one of them may take a high position. The Star of the West is dropping behind. It seemed more a comet than a star, from its eccentric course here. Captain Jack's claimed qualities are twice those of the Wilson, and in foliage it certainly is so; but it must bear another year at least, before I shall dig up the so-often superseded Wilson. The Great American I have not fruited. New strawberries are so often introduced with such superlative adjectives that, when a plain statement of the good qualities are made by the introducer, it may seem as if the faint praise was in itself a condemnation. I think the circular of A. Miller (of whom I only know through them) is in this respect worthy of imitation.

Every farmer who reads the *Country Gentleman* should have for his own table a bed of Charles Downing, for two reasons; that it is a good berry, and will bear neglect, returning good for evil far better than onions or potatoes. A few Kentuckies mixed in will give firmness and brilliancy to the mass. Epicures and amateurs can have a yet finer dish and longer season from the following list: Monarch of the West, Wilder, Cumberland Triumph, Black Defiance, White Pineapple, and, under proper conditions of soil and culture, Jucunda, Triomphe de Gand, and Dr. Warder. A good list for market in order of value is Seth Boyden, Wilson, Monarch of the West, Wilder, Downing and Kentucky (mixed), Nicanor, Green Prolific, Col. Cheney; the last two mixed with Kentucky or Boyden, to bear properly.

E. B. UNDERHILL.

Poughkeepsie, N.Y.

SUCCESS WITH PEACHES.

WE cannot grow peaches with success except we prune the trees every year; leave but a single tree unpruned and its leaves are a light, sickly green, bears one or two crops of peaches, and that is the last of the tree. Where trees are pruned every year, cutting back more than half of the growth of the season, peach trees bear from 15 to 20 years, and some even more. Trim the ends of the limbs about September, to check the growth, and after the leaves have fallen, shorten and thin out limbs as much as is desirable.—*Fruit Recorder.*

MIASMATIC ALGÆ.

MM. LANZI & G. TERRIGI have published at Rome an account of observations on the microscopic fauna and flora of the marshes in the Campagna, and endeavor to show that there is a connection between the product of changes in the cells of certain algæ and the cause of malarial fever. Dark granules form in the cells, which at last they fill, and then the algæ rot. They cultivated the plants in an aquarium, and followed the process in all its stages. The algæ develop in the marshes which are formed in winter and spring. When the moisture disappears under the heat of summer, the surface of the ground is left covered by a layer of stinking algæ. The same conditions are found, although not to the same extent, even where there are no marshes, the uncultivated ground being covered more or less with putrefying vegetable matter. The authors believe that the dark granules act as a ferment. They are found in the atmospheric dust of the Campagna, from which they can be developed abundantly by cultivation. Lanzi believes that they are identical with the pigmented sphærobacteria of Cohn and the bacteridium brunneum of Schroetter. The authors assert that the pigment-granules found in the liver and spleen of persons who have suffered from malarial cachexia are similar to the granules from the algæ cells; and Lanzi affirms the identity of the malaria melanin of pathological anatomists with the granules which result from the decomposition of these plants. The germs were found in the atmosphere of the Campagna to a height of fifty centimetres above the surface of the marshy soil. Lanzi found abundantly malaria melanin in the liver and spleen of guinea-pigs which had breathed for a considerable time air of the marshes which contained these organisms.—*British Medical Journal.*

SPIRAL CURVES.

ABSOLUTE uniformity in the use of all the terms employed in descriptive botany cannot be expected, but when a word sometimes means one thing and sometimes the very reverse, it is desirable that botanists should agree in which sense it is to be applied, and all follow one rule. With regard to the use of the term dextrorse and sinistrorse, as describing the direction of the growth of a twining plant or the overlapping of petals, some writers imagine themselves in the center of the spire, while others take their position outside. Consequently, unless it is actually stated in which sense these terms are used, the reader is left in doubt. At a late meeting of the Botanical Society of France, M. A. De Candolle advocated Linnæus' rule, as given in the 1751 edition of his *Philosophia Botanica*: "*Sinistrorsum, hoc est quod respicit sinistrum, si ponas te ipsum in centro constitutum. Dextrorsum itaque contrarium.*" Many eminent botanists, including De Candolles, have followed this rule; but in this country the majority of botanists, we believe, describe the spires as dextrorse or sinistrorse as seen from the outside. Thus Darwin in his paper on twining plants, and Bentham and Hooker in their *Genera Plantarum*.—*Academy.*

HIGHLY SENSITIVE DRY PLATES.

By Ernest Boivin.

The cleaning of the plates should be done with soda or potash, and, after several washings in ordinary water, they are covered by means of a buffer with a thick mixture of chalk and water. The success of sensitized plates in the dry state absolutely requires an alkaline cleaning, whilst, on the contrary, wet collodion requires an acid cleaning. This operation may be performed beforehand, and to use these plates it is only necessary to remove the chalk with a piece of flannel, exclusively used for this purpose, and pass over them a badger brush before covering them with the following preparation:

Albumen (the white of one egg)	30 c.c.	(8 fl. drs.)
Water	70 c.c.	(19 fl. drs.)
Ammonia	1 to 2 c.c.	(¼ to ½ fl. drs.)

Reduced to a state of froth, and after repose filtered through paper.

After complete desiccation, the albumenized plates are placed in a grooved box, to be used when wanted.

The collodionizing of these albumenized plates is done preferably with old collodion, or with a mixture of two-thirds new collodion and one-third of old.

Sensitizing is done in the following silver bath:

Water	100 c.c.	(3½ fl. ozs.)
Nitrate of Silver	8 grammes	(123 grs.)
Acetate of Lead	1 "	(15 grs.)
Crystallizable Acetic Acid, a few drops.		

It is very advantageous to expose the sensitizing bath to full light for some time, and to filter before using it; thus are avoided the fogs and reductions which may occur in the development—a very frequent cause of failure in sensitized dry plates.

After sensitizing, which requires about three minutes, wash, first in water slightly acidified with acetic acid; then cover the sensitized coating, 1, with a solution of phosphate of soda at 3 per cent.; 2, of gallic acid at 1 per cent., and, without washing, with the following preserving varnish:

Water	100 c.c.	(3½ fl. ozs.)
Pure Dextrin	9 grammes	(139 grs.)
Gum Arabic	1 "	(15 grs.)

Made with the application of heat, and after the addition of a few drops of acetic acid filtered through paper.

The plates thus prepared are placed on the dryer so as to obtain a regular and complete desiccation; they will preserve their quality for at least a fortnight. The preserving varnish may be kept a long time without becoming decomposed or turbid, especially if it is kept in a place of cool and equable temperature. The time of exposure varies according to the lens used; for example, for a simple quarter view lens, an exposure of from ten seconds to one minute will be sufficient by using the stop whose opening measures one centimetre—four-tenths of an inch.

DEVELOPMENT OF THE IMAGE.

The exposed plate is first plunged into very pure water, then into another dish containing tepid water; it is washed for the last time, and then exposed to the following reducer:

Water	250 c.c.	(8½ fl. ozs.)
Gallic Acid	1 gramme	(15 grs.)
Pyrogallic Acid	0, 3 d., "	(4½ grs.)
Acetic Acid	3 c.c.	(¾ fl. drs.)
Alcohol	3 c.c.	(¾ fl. drs.)

In which are placed, at the moment of the immersion of the plate, a few drops of a solution of phosphate of soda at 3 per cent., and a few drops of acetate of lead of the same strength, to which has been added a little acetic acid. After a few minutes the plate is withdrawn, and a trace of solution of silver at 3 per cent. is added. The plate replaced in this energetic reducer soon shows all its details, and then additional nitrate of silver is added so as to obtain the necessary vigor.

The strengthening, if it is necessary, is done in the ordinary manner, and the fixing with a solution of hyposulphite of soda at 20 per cent. The plates are allowed to dry before varnishing.

A few words on the theory of this process, which enabled me to obtain last summer splendid negatives of trees.

The albumen is used to give to the sensitized coating an organic matter capable of absorbing the iodine set free by the action of the light, and at the same time to keep the collodion on the plate.

The acetate of lead in the silver bath acts as would the acetic acid to avoid fogs, but with this difference, that it has no retarding action.

In causing the light to act on the sensitizing bath the organic matters are reduced, which, afterwards separated by filtration, are no longer the cause of the fogs so common in dry processes.

The phosphate of soda, used after sensitizing, has for effect to change into phosphate of silver, very sensitive to light, the last traces of nitrate of silver left by the washing, and which in a short time would affect the sensitive coating.

The gallic acid is the principal agent; it acts at the same time as a sensitizer and a preserver of the sensitiveness.

The preserving varnish serves to protect the iodide of silver from contact with the air. It absorbs, as does the albumen, the iodine which has been set free during the exposure, and prevents any molecular change in the desiccation of the collodion. This osmotic varnish is very easily dissolved and removed by the washing, especially when hot; it also allows the reducer to have all its activity upon the impressioned sensitized coating.

The phosphate of soda and the acetate of lead, added to the reducer, increase the reducing power about fifty times, and, besides, they considerably increase the intense greenish-brown deposit so favorable to printing positive prints.—*Moniteur de la Photographie.*

Silvering Photo Paper.—For silvering paper, silver 50 grains to the ounce of water, you mix half gallon of the solution; then pour in about fifty to one hundred drops of muriatic acid and that makes the solution milky-looking; then pour about half that quantity twenty-five to fifty drops of ammonia into it; test, and if neutral, all right; if not, keep adding a few drops at a time of the ammonia till it becomes so; then filter, and it is ready for use. It always keeps in good working order and never discolors. When weak or near used up, strengthen with the same proportion and it is O K again.

A PHOTOGRAPH TEN FEET LONG.

At a recent meeting of the Philadelphia Photographic Society, Mr. Clemmons gave an interesting account of the manner in which he successfully albumenized a single sheet of paper, measuring 10 feet 7 inches by 20 inches, which was afterwards used for a mammoth print of the Centennial Grounds from George's Hill. A wooden dish was constructed 11½ feet long by 27½ inches wide; this was first painted white inside, then coated with shellac and finally waxed, pure beeswax being well rubbed into the seams by means of a large piece of cork. The salted albumen was now poured in, covering the bottom to the depth of about $\frac{3}{16}$ths of an inch all over, and it required the whites of 125 dozen eggs. The paper, after being floated, was carefully lifted off by two persons, and secured to a long pole by its upper edge, galvanized iron tacks being used for this purpose. Seven different negatives, each 18x22 inches, were used in the printing, the edge of each being blended with care into that of its fellow. For making the negatives, the back combination of a 21-inch Ross symmetrical lens (42 inches focus) was found to be the only lens at hand giving the required field and definition. Photographed by F. Gutekunst, Esq.—*Philadelphia Photographer.*

THE CHEMISTRY OF COAL.

In the sixth and concluding lecture of the course, Dr. Frankland first recapitulated briefly the main features of the manufacture of coal gas, as described in the preceding lecture. He then referred to the properties of the diluting gases, hydrogen, carbonic oxide, and marsh gas (or fire-damp), which are present in large quantities in the gas, but contribute nothing to the luminosity of the flame. The following facts enable us to compare these gases one with another, so as to determine which is the least harmless; the greater the quantity of heat evolved in combustion, and of carbonic acid generated, the more objectionable the gas. Of hydrogen, 1 cubic foot measured at 60° F. and 30" barometric pressure, consumes ½ cubic foot of oxygen, generates no carbonic acid, and heats 1 lb. 13 oz. of water from 32° to 212° F., or 2,500 cubic feet of air from 60° to 66 4° F. Of carbonic oxide, 1 cubic foot consumes ½ cubic foot of oxygen, generates 1 cubic foot of carbonic acid, and heats 1 lb. 14 oz. of water from 32° F. to 212° F., or 2,500 cubic feet of air from 60° to 66 6° F. Of marsh gas, 1 cubic foot consumes 2 cubic feet of oxygen, generates 1 cubic foot of carbonic acid, and heats 5 lbs. 14 oz. of water from 32° to 212° F., or 2,500 cubic feet of air from 60° to 80 8° F. It is obvious, therefore, that hydrogen is the least and marsh gas the most objectionable ingredient as a diluent. In 5 cubic feet of London gas there are usually about 2½ cubic feet of hydrogen and 2 cubic feet of marsh gas.

As to the source of luminosity in flames, it was due to the presence of heavy vapors, and that the light from ignited gases increased with the increase of density. A great deal depends on the mode in which the gas is burnt. At first it was burnt in a simple tubular jet, which is the worst way in which gas can be burnt to give a good luminous effect. This is due to the fact that the gas rushes out with great velocity, and therefore the luminous vapors remain for a short time only in the flame; and, moreover, the gas as it issues mixes with a large quantity of air, which enables these vapors to burn inside the flame, where they add nothing to the luminosity.

One of the greatest improvements ever made in the burning of gas was made by a Manchester gentleman, whose very name is now forgotten, when he allowed two of these jets to impinge against each other, by which means the velocity is greatly checked and the light wonderfully increased. This is the principle of the fish-tail burner, the most common burner in the country, which has two holes bored in it in such directions that the jets of gas impinge on each other.

In the Argand burner there are a number of jets arranged in a circle, and air is supplied to the inside and outside; unless, however, the consumer is something of a philosopher and pays attention to the proper regulation of the supply of air, he will burn much gas to waste. The Argand was further improved by Mr. Leslie, who also introduced chimneys of various lengths, by means of which the nature of the flame could be regulated according to the requirements of the consumer.

As a rule, the improvements in the burning of gas consists mainly in checking the velocity, so as to allow the luminiferous gases to remain longer in the flame. For a long time no one thought of further checking the velocity in the fish-tail burner, till Mr. Scholl hit on the project of introducing into the flame a small piece of platinum—called a "perfecter"—upon which the jets impinged, and by this means the luminosity is increased.

The bat's-wing burner is also very common; the orifice in this consists in a fine slit, and since this is more liable to get stopped up than the holes in the fish-tail burner, and for other reasons, on the whole the fish-tail is superior to the bat's-wing.

Out of coal and coaly matters we now extract paraffin oil, which is of great utility as a light-giving material; it is identical with petroleum, which is in fact produced by a natural distillation of coal. In this small lamp, which only costs about 7½d. complete, we are getting for the cost of one candle a beautiful white light, equal to that of five or six candles. Also there is extracted the beautiful white solid paraffin, of which candles are made. The great advantage of these materials is that they contain no diluting substance, all their constituents—carbon and hydrogen—are useful for luminous effects. Moreover, for the same amount of light they heat the air far less, and vitiate it to a much smaller extent, than does coal gas. Owing to these and other substances obtained from it, coal tar, instead of being regarded as a nuisance and worthless as it formerly was, is now a very formidable rival in value to the coal gas itself.

The great cheapness of coal gas and paraffin oil over the old sources of light may be seen from the following comparison of cost of the light of 20 sperm candles, each burning for 10 hours at the rate of 120 grs. per lb.:—Wax, 7s. 2½d.; spermaceti, 6s. 8d.; tallow, 2s. 8d.; sperm oil, 1s. 10d.; coal gas, 4½d.; cannel gas, 3d.; paraffin (as candles), 3s. 11d.; paraffin oil, 3d.; rock oil, 3d.

COAL COLORS.

The coal tar has been investigated chemically, and its constituents have been taken apart; altogether at least 50 different things have been extracted from that black material. From some of these the now well-known coal tar dyes are made. The four most important for this purpose are benzol, phenylic-alcohol, anthracene, and alizarine. The most important of these is, perhaps, anthracene; although it was the last to be discovered, and in the last three years it has effected a complete revolution in the dyeing trade. It is obtained in the distillation of coal tar as a solid substance, which is filtered out by means of cocoa-nut matting, or some such material. It yields a dye which is identical with that yielded by the madder root, so that now we can manufacture from our own resources a sufficiency of this dye material, whereas before we were dependent on imported madder from Turkey, Holland, and France.

The dye is known as alizarine, and is used for dyeing calico, and also woollen and silks, the former requiring a much longer space of time than the latter. In dyeing calico a fixing material, or "mordant," has to be applied, the two principal mordants employed being oxide of iron and alumina. The color produced varies according to the mordant employed, and it is this great variation of colors which can thus be obtained in one and the same bath which renders alizarine so very valuable as a dyeing agent. Thus, with alumina you get a scarlet or a light pink, with iron you get a purple, with a mixture of alumina and iron you get a chocolate, while if you use much of the iron you get a purple so intense as to appear almost black—all these are perfectly "fast" colors.

The colors used for wool and silk are derived principally from that compound called benzol, which consists of carbon and hydrogen. By acting on benzol with nitric acid you get nitro-benzol, and by further treatment the latter yields aniline. This aniline requires to be brought in contact with an oxidizing agent to produce color. A single drop of aniline in a jar of water, containing chloride of lime, produces an intense coloration. This color, however, is fugitive, and was long known, but it was not till Mr. Perkin thought of oxidizing by means of bichromate of potash that a permanent color was obtained, and to this color the term "mauve" is commonly given. Magenta was discovered soon after mauve, and its manufacture has been brought to great perfection, especially in this country. It can be made by a number of different processes, but it is now made from the aniline almost exclusively by the action of arsenic acid. It can very readily be produced by heating aniline with corrosive sublimate. The manufacture of these colors from our native coal has made us rather color exporting than importing people; and, as regards alizarine, we are now entirely independent of vegetation, and a good deal of indigo is also now produced in a similar way.

When aniline purple was first prepared it was for a length of time sold at seven times the price of pure silver. A cake of it 69 oz. in weight will dye of a deep tint 1,428 lbs. of wool or silk, equal to the wool obtained from 250 sheep. From 30 cwt. of coal 365 lbs. of tar are obtained, which furnishes 18 lbs. of naphtha, containing 6 lbs. of benzol; from this 6 lbs. of benzol (the starting point of mauve and magenta) 5 lbs. of aniline are produced, from which, again, 1 lb. of mauve or magenta can be obtained, sufficient to dye 560 lbs. of silk, or 960 lbs. of wool. In other words, 4 lbs. of coal will yield enough benzol (aniline itself is present in coal tar, but in too small quantities to be practically separated) to produce magenta sufficient to dye 1 lb. of wool. [The lecture was abundantly and beautifully illustrated by actual dyeing processes, etc., as well as by numerous dyed articles.]

The lecturer then concluded by remarking that we had rapidly traveled through the history of coal; we had seen it start into existence in early ages through the sun's force; buried in the earth its tremendous powers lay dormant, till in the present day we have taken it from its prison and made it yield up its force. Treated in one way it shows itself as light, in another way as heat, in a third as mechanical force, and in a fourth as color; and he thought his audience would indorse his opening statement that coal was one of the most remarkable substances in nature. A most enthusiastic vote of thanks to the lecturer closed the proceedings.

OSTRUTHIN.

Two years ago Gorup-Besanez described, under the above name, an interesting body which he had extracted from the root of the Master-wort (*Imperatoria Ostruthium*, Linn). The substance was prepared with difficulty; as it constituted only ½ per cent. of the root. He has since worked on 200 kilog. of material, and by modifying his method of extraction has succeeded in obtaining a yield of 0·58 per cent., and sufficient of the ostruthin for a full investigation of its properties. Ostruthin contains no nitrogen, and possesses the empirical formula $C_{14}H_{17}O_5$; it is insoluble in cold water, almost insoluble in hot water, and easily soluble in alcohol and ether. The crystals belong to the triclinic system, and are optically biaxial. The alcoholic solution of ostruthin is somewhat fluorescent; when the liquid is diluted with water it exhibits a blue fluorescence which rivals that of æsculin in beauty; when dissolved in aqueous ammonia ostruthin shows a yellow fluorescence. With hydrochloric and hydrobromic acid it forms well defined crystalline neutral compounds, containing one equivalent of the organic body and one of the acid. When treated with acetic acid it forms monoacetylostruthin; ostruthin, therefore, contains only one hydroxyl group, the second atom of oxygen which it contains playing a different and as yet unknown *rôle*. While ostruthin resembles terpin in its deportment with the above mineral acids, the resemblance cannot be traced in the action of nitric acid; when the latter is concentrated the new body is converted into oxalic acid; when weak into styphnic (oxypicric) acid. By treatment with chlorine no well defined result was arrived at; bromine, on the other hand, formed a tetrabromostruthin, as well as, probably, a tribromo compound (*Annalen der Chemie*).—*Academy.*

POTASSIUM TRIIODIDE.

A paper on the formation of this new iodide was recently read before the Chemical Society by G. S. Johnson. He finds that if a saturated solution of iodine in water saturated with potassium iodide be allowed slowly to evaporate over strong sulphuric acid, cubes of potassium iodide colored by iodine first separate, and after the lapse of some days dark blue, almost black, lustrous prisms of triiodide are formed. The new body is extremely deliquescent, and must be preserved in perfectly dry air; it fuses at 45° C., and when heated it readily evolves iodine, the moniodide remaining. When thrown into water it easily decomposes, a part of the iodine is precipitated, the remainder dissolving in the moniodide. The specific gravity of the new salt, determined in its own mother liquor, was found to be 3·342; it crystallizes in the oblique prismatic system.—*Academy.*

TEST FOR SUGAR.

Vidau has observed that a mixture of equal parts of hydrochloric acid and oil of benne (*Ol. Sesami*), either in the cold or when slightly heated, assumes a distinct rose color in the presence of cane or grape sugar, provided not less than 0·001 gm. ($\frac{1}{64}$ gr.) of sugar is present for every cc. (16 3 min.) of mixture.—*Journ. de Ph. et de Chim.*

COATING METALS.

IN the process of coating iron or other metal sheets with tin or other metal, Mr. E. Morewood, of Llanelly, England, employs what he calls a half round finishing flux pot with machinery and apparatus so fitted that plates which have been coated with melted metal after being prepared by tallow, oil, or grease flux may be finished, improved, or rectified whilst making a somewhat semicircular travel under the hot grease, tallow or oil contained therein by passing between rollers coated with melted metal. At the bottom of this finishing flux pot is an opening by which any molten metal, or scruff, or dirt, or settlings from the grease descend from the said finishing flux pot into a receptacle which is set below, so that the rollers, som of which work near the bottom of the finishing flux pot, may, whilst revolving, be as far as possible out of the way of disturbing dirt, scruff, or settlings, or of planting any on the plates which pass between them, and from the receptacle the metal, grease and dirt can be readily removed. On the exit site of this finishing flux pot or vessel he causes the plates to pass up between rollers working in troughs containing melted metal, so that they may be supplied with fresh coating metal whilst passing between the rollers which revolve in contact with the coating metal contained in such troughs; or such troughs may contain fresh tallow, oil, or greasy matter of the quality and condition best suited to finish coated plates. He prefers to use such half round finishing flux pot in combination with a half round tinning pot; and the plates to be coated are passed into the melted coating metal contained in such half round tinning pot through grease contained in a special flux box; and on the exit side of such half round tinning pot he causes the plates to pass out between rollers revolving in troughs. He also finds it desirable to use an additional pair of rollers close to the surface of the melted metal on the exit side of the tinning pot, and under or between the legs of the said trough. Between the half round tinning pot and the finishing flux pot he sometimes places a dipping pot containing melted coating metal of good quality, and into this dipping pot he occasionally dips the plates as they pass from the said half round tinning pot into the said finishing flux pot. The arrangement of an opening and receptacle for scruff, dirt, or settlings may be adapted to the grease flux on the exit side of a pot, in which the plates in process of coating pass up from the coating melted metal to and through the finishing flux before coming in contact with the air.

STRUCTURE OF PRECIOUS OPAL.

AT a recent meeting of the Academy of Science of Philadelphia, Professor Leidy stated that Signor A. G. Arevalo, proprietor of one of the opal mines in Queretaro, Mexico, had recently called upon him, and exhibited a large collection of cut opals of various kinds, comprising the milk-white opal with a rich harlequin display of colors, the less valued transparent glassy variety with rich hues, and the red fire opal of different shades, also displaying the play of colors of the spectrum. From among them he had selected several which he exhibited to the Academy as illustrating in an unusually distinct manner the structure of the precious opal. One of the specimens is white opal, emitting on one side from the free surface a brilliant display of colors. These are reflected from facets ranging from $\frac{1}{4}$ to 1 mm. in breadth, and of irregular polyhedral form. The facets are distinctly separated by fissures, which in the polishing of the stone, have become more or less filled with dirt, and they appear to form the surface of a mosaic pavement laid on a basis of amorphous opal, of which the other side of the specimen consists. The facets are distinctly striate; the striæ being parallel on the same facet, but changing in direction on the different ones, though pursuing the same general course over comparatively large areas, as represented in the same figure. The striæ, or tubes as Sir David Brewster considered them to be, vary in degree of fineness; some apparently being double or more the thickness of others. He had not attempted to measure them accurately, but they appear to be about the size of the lines in the ordinary micrometer eye-piece of the microscope. There appeared usually to be about four or five striæ in the space of $\frac{1}{16}$ of a mm. Another specimen is a dark carnelian-hued fire opal, which exhibits in directly looking upon it, just beneath the surface, a patch of round or oval spots of a deeper hue. The spots range from $\frac{1}{4}$ to 1 mm. in breadth, and are separated by interspaces from $\frac{1}{4}$ to $\frac{1}{8}$ of a mm. The spots appear as lenticular disks with finely striated surfaces; the striæ being parallel, and on the different spots pursuing nearly the same course. Viewed at a certain angle, they mainly emit a rich golden-green hue. In another opaque white specimen, emitting rich hues, the striated facets are more or less isolated by amorphous opal, and vary much in size. The smaller facets are generally irregularly oval; the larger ones appear to be made up of an aggregate of the smaller kind. Over comparatively large areas, the striæ of the different facets pursue nearly the same direction, but in contiguous areas they even pursue quite opposite directions. On the larger patches, also, as I have attempted to represent them, the striæ are not perfectly continuous, but appear to be rather interrupted in bands. On another part of the same opal the brilliant patches would appear to pertain to cylindroid or fusiform rods of the striated opal imbedded in amorphous opal. The striæ in these rods appear to be arranged in regular parallel layers, so that either longitudinal or transverse sections give rise to the appearance of parallel striæ. From these specimens precious opals would appear to be constituted of an aggregation of particles of a striated or finely tubular structure, which may be imbedded in a basis of more amorphous opal. When isolated by the latter, the particles may appear as lenticular disks, round or oval balls, or cylindrical rods with rounded ends and of variable length. When closely aggregated these particles become more or less polyhedral. The particles in section in any direction present a striated appearance, and, according to the varying fineness of the striæ, and their inclination, emit the varied hues for which the precious opal is so much admired.

LOSS OF SILVER.—A NEW INVENTION WANTED.

THE enormous slag piles that grace the neighborhood of our furnaces stand in the same relation to our mines as the tailings of the stamp mills do to the free milling ores, with this one unfortunate difference: that, while the tailings can be reworked cheaply and the precious metals extracted, no process can do the same for the slag at a rate that will give any profit. The slag pile represents a waste of from eight to ten per cent. on all the ore smelted, and carries quite a percentage of lead and silver. It is roughly estimated that the dump at the Eureka Consolidated contains at least $1,000,000 of the precious metals, and the Richmond as much more. As great quantities of this material has been used to fill up our streets we can boast that they are literally paved with silver, and we doubt not but that a sample of dirt from Main Street would yield a good assay. Our citizens are familiar with the picturesque sight at the furnaces where the molten stream is constantly pouring into the iron pots from the hearth. The specific gravity of the lead and its affinity for silver carries those metals to the bottom of the furnaces. On the top of these float the melted iron, and again on that metal float the lighter impurities of the ore, consisting of silica, etc., and technically termed slag. The hearth is provided with two spouts, one some three inches higher than the other. The top spout is continually running and carries off the slag, which is wheeled away, and forms the principal component of the dump pile. At intervals the lower spout is tapped, the melted iron run off, and the cubical castings that ornament the surface of the slag piles are the result of this operation. The smelters exercise great care in handling the iron, as in cold or damp weather the least moisture coming in contact with it will produce a violent explosion, scattering the molten mass in all directions. At the side of each furnace there is a receptacle, called a lead well, communicating with the bottom of the furnace by a pipe running into it. The melted lead runs into the well through this pipe and is ladled out into moulds, forming bars, averaging 115 pounds in weight. This is the base bullion in a form ready for refining. The time may possibly come when the refuse of the furnace can be utilized and reworked, but at the present cost of smelting there is no probability of such a process. In the meantime it can be used to grade and repair the streets, and its merits in that direction are too important to be overlooked.—*Eureka Sentinel.*

MICROSCOPICAL NOTES.

PODOPHRYA FIXA.

M. E. MAUPAS has a paper in *Comptes Rendus* on the motile condition of the well-known infusorian *Podophrya fixa*. He found numerous specimens among fresh-water algae in streams near Algiers, sometimes free, at others fixed by their long peduncles. Free or fixed, their bodies were always round, sometimes perfectly regular, and the suckers were distributed regularly all over the body, except at one spot where the contractile vesicle is seen. Closely observing these creatures, he noticed, at periods of from half an hour to an hour, the suckers slowly contract and re-enter the body. At the same time, the region destitute of these appendages became gently depressed, and formed a large furrow, which soon gave the body a reniform aspect. The surface of the furrow, when strongly magnified, exhibited rows of minute points, or projections, which elongated themselves. Finally, these projections grew into long slender cilia, the body elongated, the suckers disappeared, and the *podophrya* swam freely, turning on itself. After passing some time in this condition, the processes were reversed, the suckers began to reappear, the body to grow shorter and broader, and the vibratile cilia to retract. In about twenty minutes the original aspect was resumed. The whole group of creatures under the names *Actinophryina* and *Acinetina* requires to be re-examined. The well-known acinetan theory of Stein, abandoned by him of late years, was partly founded upon errors connected with *Podophrya fixa*. Dujardin rejected *Podophrya* as a distinct genus; Pertz named one form *P. libera*, which was stemless, and the researches of Messrs. Dallinger and Drysdale show that without many months of continuous observation it is impossible to work out the life-history of some infusorians, or to say what discrepant-looking forms are stages of the same species. *P. fixa* has been so long observed by so many microscopists, from Ehrenberg downwards, that we cannot suppose the changes noticed by M. Maupas to be common. In Pritchard's book, *P. fixa* is stated to be "found among dustlike matter upon the surface of pond-water."

CURIOUS EXPERIMENT WITH DIFFRACTION PLATES.

At the January meeting of the Royal Microscopical Society, Mr. Stephenson exhibited some curious optical experiments with diaphragms and ruled diffraction gratings, contrived for the purpose by Prof. Abbe of Jena. One of these gratings is formed by ruling a band of vertical lines so as to cut through a silver film on a glass disk. In the upper part of this band the lines are about at the rate of eighteen in the $\frac{1}{17000}$th of an inch. In the lower part there is an additional line in each interspace. If a diaphragm cut in a piece of card with three slits $\frac{1}{16}$th of an inch wide and the same distance apart is placed in an inch and a half objective, the coarser lines appear doubled when the slits are parallel to the lines; when the slits are at right angles to the lines, the latter appear as they are. The effect varies somewhat according to the dimensions of the slits and their distance apart. If too wide the experiment does not succeed. With slits of the size mentioned, and B and C eye-pieces, we noticed, on rotating the slits from their position at right angles to the lines, which shows the latter as they are, that at about 45° there springs up an additional line in each white interspace. When the parallel position is reached, the doubling of the coarser lines is so effected as to make them coincide, line for line, with the finer set below. Other gratings are ruled with lines crossing at right angles and obliquely. Those which have their lines at right angles are truly seen when the slits are vertical or at 90°, but give oblique patterns at 45°. The nature of this action is well shown by using a diaphragm with a single central fine slit. This renders the coarser lines easily visible when at right angles to them, and they cease to appear at 45°, or when parallel. A diaphragm with a small round hole allows no lines to be seen—the exact size depending upon the objective employed. Round holes of a certain size give the crossed gratings hexagonal markings. These experiments show conclusively that diffraction effects must be carefully studied to enable the microscopist to avoid errors of interpretation. The precise conditions of gratings, etc., will not, of course, be repeated in physiological or other objects, but analogous causes of error may be introduced. We hope Prof. Abbe's experiments will be extensively repeated.

EXPERIMENT WITH MERCURY GLOBULES.

At the same meeting a slide, prepared by Mr. Slack, was exhibited to show the action of small mercury globules mounted in balsam on polarized light. The globules should be of such a size as to look about the eighth of an inch or less in diameter, when viewed with one sixth or one eighth objectives. The polarizing prism should be placed beneath an achromatic condenser, and a strong light thrown up. When the analyzing prism is turned so as to give a dark field, the globules look semi-transparent with luminous margins and four dark marks like an incipient cross. The focus for this optical effect is rather lower than that for viewing the surface of the globule. Pereira, in his work on "Polarized Light" (edit. 1854, p. 137), noticed the action of bubbles in balsam. In this experiment the reflecting surface of the mercury seems also to operate. Each globule appears surrounded by an empty space as the mercury contracts in cooling and leaves the balsam.

MICROSCOPIC LANTERN.

A want felt by physiological and other lecturers has just been supplied by Mr. Browning, who has contrived a new nose piece for lanterns to exhibit microscope slides of the usual 3x1 inch size on a screen. It has additional condensing lenses to reduce the pencil of light from electric to oxy-hydrogen apparatus to the right size, and a microscopic apparatus carefully made with achromatic lenses and a suitable eye piece. The image should be thrown upon a good paper screen, and it will be found that many injected preparations, parts of insects, etc., can be effectively displayed to a considerable audience. The definition is extremely good, as will be found by going close to the screen and noticing the sharpness with which minute hairs, tracheal tubes, and similar structures, are displayed; but, of course, anything that is required to be visible many feet off must be capable of presenting a distinct outline at such a distance. The light of the paraffin lamp belonging to the sciopticon is not sufficient for this purpose, but perhaps some of the most brilliant of the new duplex lamps might suffice for private exhibition. Changing this nose piece for that usually employed for larger slides, or *vice versa*, is a quick and easy process.—*Academy.*

HOW TO RESOLVE TEST-DIATOMS WITHOUT ANY SPECIAL APPARATUS.

THE Rev. J. Bramhall writes as follows to the *Science Gossip*, and as he is an authority on the subject, we think his remarks worthy of quotation: "Turn the instrument at right angles to the sun; close the diaphragm so as to cut off all light below the stage; or, if that cannot be done, place a piece of black paper behind the slide. Bring the light on to the object at the angle which suits it best. This is easily done by moving the microscope to the right or left. If necessary, increase the light by the use of the stage or stand bull's-eye condenser. That is all. A black ring round the covering glass is an objection when the cover is small, as it interferes with the light. To carry out this plan successfully, only two things are necessary—viz., the sun, and an object-glass, capable of resolving the test, just before it. It is not intended to supersede the use of the apparatus, for the sun is far too uncertain an illuminator to be depended upon, and most men work by night; but it may be useful to those who cannot afford to purchase any apparatus—not even an oblique illuminator, the cheapest of all. I must justify this allusion to my *pet child* by stating that I have not, and never have had, any pecuniary interest in its sale. Having been asked questions as to its capabilities, I can only repeat what I have before stated, viz., that by its help I can resolve tests which I never could touch before, though possessing achromatic condensers, spot lens, etc."

NEAR-SIGHTEDNESS.

IN the course of some remarks lately made before the Medico-Legal Society of the city of New York, by Cornelius R. Agnew, M.D., he said: "I was very much interested in the reports of Cohn, of Breslau, published many years ago, containing observations as to the condition of the eyes of children in the villages surrounding that city, and in the schoolhouses of the city, and in its University. He found that, among the children in the villages, the amount of near-sightedness was very small—not exceeding two per cent. He made this result a basis for further operations, assuming that two per cent. might be accepted as indicating as near an approach to the normal eye as found anywhere, and continued his examinations through the primary and other schools of the city of Breslau, and into its University. He found through all the schools, as they rose in grade, a progressive near-sightedness among the pupils, until the University was reached, where it was found to be present in a most appalling ratio, reaching as high—if memory serves me—as sixty or seventy per cent. Now, we all know that the peasant children in that country live in a state of comparative simplicity, and do not use their eyes to any great extent upon work which involves strain. Other observers, in other parts of Europe, followed with observations made in the same direction, and reached nearly the same results. When I came to consider the subject here, and talked to some of my friends concerning it, I was met with the statement that in this country the conditions were peculiarly favorable for the children; that in Germany the dietary was not as good as here; that the schoolhouses were not so well built; that there was a system of education in that country which was much more severe than that in practical operation here; and that the children were put in those schools, and kept under that system continuously, from the tender age of six or seven years until they had passed through the University; and that this continuous strain, added to the dangerous sanitary construction of the schoolhouses, and the deficient salubrity of the homes, produced a state of affairs which could scarcely be expected to be present in this country. As a matter of course, I was not able to accept such a statement, and it occurred to me to have tables arranged, like those of Cohn, and try and have observations made in the city of New York, and also in the cities of Brooklyn and Cincinnati.

"When these tables were returned, and the observations summed up, it was found that the result obtained in New York, Brooklyn, and Cincinnati had a striking correspondence to those obtained in Breslau; and that near-sightedness increased as we ascend from the lowest to the highest schools in New York, Brooklyn, and Cincinnati, in about the same ratio as in the city of Breslau. We, of course, then immediately rejected the idea that the children of Breslau and its vicinity were under influences peculiar to that country. I then felt very desirous of arriving at some conclusion, if possible, as to how far the system of education generally pursued in our schools might be charged with bringing about, in the eyes of scholars, a state of affairs which intelligent persons would be compelled to regard as objectionable. Now, while I recognized that this general increase of near-sightedness was deplorable, I by no means was forced to the conclusion that the schools themselves were to blame in this country, in so great a degree as previously supposed and as many allege. I have no doubt but that work done in schools may come in as a large factor in the production of this condition of the eyes, but I am not prepared to give any opinion as to the exact value of the factor. Statistics are like a two-edged sword—they cut both ways—and it is the part of wisdom to be careful in making deductions from them. While, therefore, there was found to be an increasing amount of near-sightedness in these schools, I was not able to satisfy myself as to how much

was due to conditions existing in the schools, and how much due to heredity, habits of life; in other words, to conditions existing in the habits and homes of the scholars.

"Progressive near-sightedness is a disease. A near-sighted eye is not a normal eye. When the child is born in the normal state the eye is not near-sighted. Now, the eye is an organ which is plastic when the child is born; it is in a condition to be changed in its shape; its tissues are in a condition to be modified by the use which is made of the organ. Commonly the child goes on until it reaches the age of eight or ten years, perhaps a little older, when it is observed that it has to hold whatever it is looking at a little nearer to the eye than previously, and then, on examination, reveals the fact that the eye is near-sighted. If you follow such a child up to the age of twenty-five or thirty years, it will be found that the near-sightedness has doubled, and perhaps quadrupled. Now, we know, by means of the opthalmoscope and other means, that the near-sighted eye is changed from the spherical to the elliptical, or ovoid form, and that progressive myopia is always marked by change in the shape of the eye. Inasmuch as the eye is made up of living tissue which is constantly undergoing the process of waste and repair, you can readily perceive that the law inducing the amount of such waste and repair is very much determined by the character of the tissue-building process in each child, and the way in which that child uses the eyes. For example, the child is allowed to sit, perhaps for hours, with the body partly bent, and the face inclined towards a book which rests in the lap while reading; here the accommodation of the eyes is taxed in looking at a minute object while they are in a bad condition, and all this time waste and repair is going on as best as it may. The child would go blind in an instant were there no tissue reproduction. Now, if the eye is used while the body is in an unfavorable position, it cannot be nourished as it should be, and the pressure of the muscles upon the eye-ball and the action of the crystalline lens in focalization must bring about changes which lead to this progressive form of disease. Then let the child go at an early age into a school-house, where, perhaps, it will be placed upon work with books, slates, or copybooks, which could be better done by means of the blackboard or models, and again the eyes are strained, and so the unfavorable effects are continued.

"It seems to me that the very etymology of the word 'education' enforces the idea that the child is to grow better and stronger up through his school life, and that by proper regulation of his diet and management at home, by properly lighted schoolrooms, and properly constructed desks, and a better regulation of his hours of study, he should represent a much higher type of life when he has reached the age of twenty-five than when he is just taken in hand with the view of giving him book knowledge. We certainly should not damage the eye in the process of education, and I believe that the damage done to the eyes is to be taken as an index of that which is done to other organs of the body."

TEST FOR ALBUMEN.

DR. W. H. KESTEVEN recommends the following method, in the *Lancet:*

Take a thin glass microscopical cover (about one inch square is the best size); on this place a drop or two of the urine to be tested; then, with a pair of ordinary dressing forceps, hold the cover over the flame of a candle. At the same time the under surface of the glass will be blacked by the smoke, and the urine will be boiled. If there is any albumen, the black under surface renders the white precipitate evident.

It may also be tested cold with nitric acid with the same apparatus. A drop or two of the urine should be placed slightly on one side of the center of the surface of the glass, and a drop of nitric acid on the other. By inclining the glass, the two will mix, and after the fumes which result from the mixture have passed away, it will be readily seen if there is any albumen precipitated.

In the first experiment care must be taken not to boil the urine too rapidly, or it will be evaporated. In the second, the resulting precipitate is rendered more apparent if the under surface of the glass has been previously coated with Brunswick black or some other dark substance. A few of these covers can be carried in an ordinary pocket dressing-case, and afford a ready means of testing urine at the patient's house.

LITHOCLYSMY; A NEW OPERATION FOR VESICAL CALCULUS.

DR. PIGNONI has designed an instrument by means of which he proposes to disintegrate and dissolve calculi while still in the bladder. He has found by experiment that nitric acid diluted with half its weight of water will rapidly disintegrate all forms of calculi, even those which contain cholestearine, the best solvent for which, however, is alcohol. Neither of these reagents exert any destructive influence on caoutchouc. In order, then, to destroy a stone while still in the bladder, it is only necessary to introduce a long caoutchouc bag into the bladder, to isolate the stone within this bag, to bring its open end out of the meatus urinarius, and to cause a double current of diluted nitric acid or of pure alcohol, if the calculus be composed exclusively of cholestearine, to pass through the bag. All this may be safely done with Dr. Pignoni's apparatus. It consists, first of all, of a straight tube, 7½ inches long, and open at both ends, through which a gum-elastic bougie passes. This is introduced into the bladder, and then the bougie is withdrawn, leaving the tube *in situ*. The bladder is then filled with warm water, and the isolating sound introduced. This sound consists of a long metallic stem, to one end of which a flexible, elastic steel hoop is attached. The open end of a caoutchouc bag is fastened to the hoop, which is then compressed with the fingers and pushed into and through the canula. Upon entering the bladder the hoop resumes its original form, and by careful manipulation the stone, provided it be not incapsulated, may be seized and imprisoned in the sac. The whole of the caoutchouc bag is then pushed into the bladder and the isolating sound withdrawn, bringing with it the open end of the bag, and leaving the closed end in the bladder enveloping the stone. The interior of the bag is greased, and three or four tapes are glued to it longitudinally, to keep it from embracing the stone too tightly. The reagent is introduced through a gold or platinum double current catheter. If the stone be of moderate size it can be dissolved in a single seance; but if it be too large for that, the solvent should be evacuated, and the bag washed out with common water, and then split open.

An extensive experience with the operation has convinced Dr. Pignoni that the increased temperature caused by the action of the solvent upon the stone does no harm. Spontaneous rupture of the bag is impossible. Even if it should occur, however, little harm could result, for the bag being almost completely filled by the stone, the amount of chemical solvent contained in it would be small in comparison with the pint or more of water it would meet in the bladder.

The action of a voltaic current of electricity, a powerful agent for decomposing calculi, might also be employed in addition to the chemical solvents. When stricture of the urethra or an enlarged prostate interferes with the operation per urethram, lithoclysmy may be performed through the perineum or the rectum, or through the hypogastrium, in preference to lithotomy or lithotrity.—*Le Mouvement Médical*, November 18th.

TYPHOID FEVER FROM WELL WATER.

By JULIUS A. POST, M.D., Rochester, N. Y.

SOME time during the early part of September last it was noticed that typhoid fever was confined to a particular part of this city (Rochester). The Board of Health took the matter in hand, and proceeded to investigate, with the following results: Most of the persons who were sick used water from a well which was located at a four corners, and situated directly in front of a grocery and lager-bier saloon. This well was a famous watering-place for farmers and teamsters, who generally left their teams standing near the well while they went into the saloon for their accustomed glass of lager. In this way the well received the surface washings, not only from the road, but from small cesspools of urine, manure, and filth which had accumulated around it. The Board of Health caused the well to be closed. This action on the part of the Board caused much excitement throughout the neighborhood, especially among those who used water from the well. At this stage of proceedings Prof. Lattimore, of Rochester University, kindly volunteered to analyze some of the water taken from the bottom of the well, and also from the surface of the water. His report being of a negative character, and showing nothing there which would be injurious to health, the people again became clamorous to be allowed to use the water. To settle the matter, the Board of Health determined to make a house-to-house inspection, as it was evident that science and hygienic laws were at variance somewhere. Taking the well as a starting point, each house in the neighborhood was visited, as far as any persons could be found who used the water. A large district was included, presenting about the same features as to drainage and sanitary conditions. The results of inspection were as follows: There were forty families who used the water from the well at the corners; the forty families contained two hundred and nineteen persons; in these forty families there had been, during the past season, twenty-three cases of typhoid fever, and one of consumption—in all, twenty-four cases of sickness. In the district inspected there were forty-seven families who used water from wells in their own or their neighbors' yards; these forty-seven families contained two hundred and seventy-one persons; in these forty-seven families there had been, during the past season, one case of dysentery, two of typhoid, one of pneumonia, one of whooping-cough, one of disease of the kidneys, and two sick for a few days, but did not call a physician—in all, eight cases of sickness. Comparing the diseases of a zymotic character in the forty families who used water from the condemned well, and diseases of the same nature in the forty-seven families who had water from wells better protected, we can draw but one conclusion. After closing the well there were no more cases of typhoid in that neighborhood than in any other part of the city. The case is a very interesting one, and only proves the more conclusively that wherever typhoid fever makes its appearance there is a direct violation of some sanitary law, and that a chemical and microscopical investigation is not, in all cases, sufficient to warrant the opinion that water taken from certain sources may not be, of itself, the direct cause of disease. —*New York Medical Journal.*

SPECIFIC AGAINST HYDROPHOBIA.

By DR. GRZYVALA.

THE writer claims for xanthium spinosum antirabic properties. Its efficacy has been tested in one hundred victims bitten by rabid animals, of whom he lost none. Some astonishing instances of the marvelous power of this drug are given, two of which are appended. Twelve persons of one family had been bitten by a mad wolf. Six of this number were admitted into the hospital of Olschanka, Government of Podolia, district of Balta, and were treated with this drug, and all recovered. All of the others, treated with the actual cautery and the daily use of genista tinctoria died with hydrophobia in from twelve to sixty days. Thirty oxen had been bitten by a mad wolf; five of them died hydrophobic. The remaining twenty-five were treated with xanthium spinosum and recovered. Of the dried leaves, powdered, the dose for an adult is nine grains, thrice daily. For children, half that dose. For the animals above alluded to, the dose was three ounces daily, given in bran. Too warm a welcome to this new aspirant for the honors of specificity against hydrophobia cannot be extended. The trustworthiness of Dr. Grzyvala is vouched for by Prof. Guber, of Paris.—*British Medical Journal.*

Xanthium spinosum, or clot weed, is a native of the United States as well as Europe, growing in the fields and roadsides from Massachusetts to Pennsylvania and Georgia. It is a plant growing about one foot high, very conspicuously armed with straw-colored spines, and possessed of distinctly sudorific properties.—ED. *Jour. and Exam.*, Chicago.

EXTRAORDINARY LONGEVITY.

DR. B. ORNSTEIN, Surgeon-in-Chief of the Greek Army, contributes the following communication (*Virchow's Archiv*, vol. lxvi.), which was received by the editor of the Greek newspaper of Smyrna: "Our fellow-citizen, George Stravarides, died to-day, at the age of one hundred and thirty-two years. Though this Methuselah led a rather intemperate life, consuming daily more than one hundred drachms of brandy on the average, he was, nevertheless, up to the last moment of his life in the full possession of his five senses, as also of his teeth. He was still quite active, could dance and sing when intoxicated, and attended in person to his occupation of baker up to the end of his days. The deceased was born in the year 1743, during the reign of Sultan Mahmoud I., and has thus witnessed the reign of nine sultans." The reporter appends the following historical considerations: "In order that your readers may have a deeper insight into the events occurring during the long life of this individual, I may be permitted to compare it from his birth with a few simultaneous historical events. At his birth the Shah Nadir besieged Bagdad. He had attained his ninth year when the unfortunate French king, Louis XVI., was born, and was fifty years old when the latter was beheaded. He was twenty-seven years old when Orloff burned the Turkish fleet in Tschesme, and thirty-one when Sultan Abdul-Hamid, father of Sultan Mahmoud II., reigned. He was older by two years than Gregory V., by five years than Koraës, by twelve years than Regas the Pherraian, and by twenty-six years than the great Napoleon."

NOVEL REDUCTION OF HERNIA.

DR. J. HOLMES JOY, of Tamworth, England, relates (*Brit. Med. Jour.*) an interesting case of hernia occurring in a lady sixty years of age, strangulated thirty-six hours, in which the taxis and all ordinary means of reduction had failed. The symptoms becoming urgent, ether spray was applied to the hernial sac, and trial was again made of the taxis, but, although a small portion of the contents of the sac was returned, the greater part remained immovable. The point of a pair of common bellows was then oiled and introduced per anum, the spray and taxis were renewed, and air was pumped slowly into the bowel. On the fourth bellowsful being pumped, the bowels were much distended, and by careful pressure and manipulation the hernia was reduced.—*Chicago Med. Times.*

ESSENTIAL OILS.

MOST of our readers are doubtless aware that aromatic vegetable substances yield on distillation essential oils or ottos, which contain in a concentrated form the peculiar odor of the plant or flower from which they are obtained. But it is not so generally known that for perfumery purposes the finest odors are extracted by a different process.

This process is usually called "maceration" by perfumers, but incorrectly so, heat being required in its use, while in maceration proper only ordinary temperatures are employed. The operation is conducted as follows: The flowers, separated from leaves or other extraneous matter, are placed in a suitable vessel and covered with oil, or liquefied suet or lard. A gentle heat is then applied to the apparatus for a period ranging from twelve to forty-eight hours, at the end of which the fat is strained from the flowers, and again digested with fresh ones, which operation is repeated four or five times, or until the fat becomes sufficiently perfumed. Fatty bodies having a particular attraction for the ottos, with little or none for the other constituents of the flower, they freely absorb the former, leaving the latter comparatively unaffected. From the greasy body so impregnated the odorous principle may be readily extracted by alcohol. The oils or fats employed in digestion being almost entirely insoluble in spirit, while the fragrant molecules they hold are readily so, an essence or spirituous solution of the otto contained in the perfumed greases is easily obtained by their simple maceration in alcohol.

The process of maceration, or, more properly, digestion, is not employed solely for the production of essences; the finest pomades or oils for the hair, and best greases for soap, are those scented directly from flowers. Occasionally vanilla, balsams, and other odorous substances, are digested in the same manner as flowers, and the scented greases resulting are, with perhaps trifling exceptions, applied only to the uses mentioned above.

Pomade is the name given to all perfumed greases which are solid at ordinary temperatures; those remaining fluid being known as antique oils, the *huiles antiques* of the French. Pomades are made of different degrees of odor, which are distinguished by the numerals 1, 6, 12, and 24, the latter denoting the strongest fragrance. It is said that these figures represent the number of times fresh flowers have been digested with the grease.

Pomades or oils after maceration with spirit, which is technically known as "washing," still retains sufficient odor to render them useful in the manufacture of a less expensive class of articles.

Absorption, or *enfleurage*, as the French call it, is substantially the same process as digestion, with the exception of being conducted without heat. The grease, when of solid body, is spread in thin layers on trays with glass bottoms called "frames," its surface being covered with owers, placed cup downward. The frames are then piled one on the other to prevent loss of odor from exposure to the air; after remaining thus from twelve to seventy-two hours, the flowers are removed and replaced with fresh ones, which are again renewed as in digestion, until sufficient odor is imparted to the grease. When oil is used, coarse cloths saturated with it take the place of the lard or suet; the scented product being finally expressed from the cloth by suitable machinery. The frames used in the latter case have a bottom of wire netting instead of glass.

An improvement on the usual process was devised some years since by M. Semeria, of Nice, France. It consists in spreading the flowers on a fine net, mounted on a separate frame, which is then inclosed between two trays, each containing a layer of grease. The distance of the net from the fatty surfaces is so arranged that the flowers shall only approach without touching, but the odor is communicated as in actual contact. Much labor and waste is saved in changing the flowers, and the resulting perfume is said to be finer. It seems likely that the ottos would be less perfectly extracted by this means than by the old process, but the saving in labor and waste of grease probably more than compensates for any increased quantity of flowers required for obtaining a given result

Absorption is used chiefly for jasmine and tube-rose flowers, the delicate fragrance of which is injured by an elevation of temperature.

The greases used for digestion and absorption must, of course, be inodorous. Benne oil and olive oil are sufficiently so in their natural state, but lard or other animal fats require purifying or deodorizing.

Although digestion and absorption produce finer perfumes than distillation, their use is practically confined to the flowers of the cassia, jasmine, orange, rose, tube-rose and violet; the ottos of all others, as also those of such herbs, barks, and other vegetable matters as are desirable to the perfumer, being obtained by the last-named process, which is less laborious, and gives products of greater concentration, and consequently greater durability of odor. The essences from the fats of the digestive process possess more of the true floral odor than the ottos of distillation, and are consequently indispensable as representatives of their respective flowers, and in the formation of compounds in which freshness of character is necessary; but the ottos are almost equally valuable, their greater strength and permanence often compensating for a lack of true fragrance.—J. H. S.—*Boston Journal of Chemistry.*

THE planting of a tree over each buried human body, is suggested as a rapid and useful method of disposing of the remains of the dead. Many a corpus, utterly worthless while living, will be thus made valuable to posterity, in the tree form.